Cost Estimation Practice for Buildings by A/E Firms in the Eastern Province, Saudi Arabia

by

Saleh A. Al-Thunaian

A Thesis Presented to the

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DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
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In

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This thesis, written by **Saleh Abdulrahman Mohammed Al-Thunaian,** under the direction of his Thesis Committee, and approved by all the members, has been presented and accepted by the Dean, College of Graduate Studies, in partial fulfillment of the requirements for the Degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING AND MANAGEMENT.**

Thesis Committee

Chairman (Dr. Ali A. Shash)

Member (Dr. Abdulaziz A. Bubshait)

Member (Dr. Fahd Al-Said)

Member (Dr. Sadi Assaf)

19/6/96

Dr. Ali Ali Shash
Department Chairman

Dr. Ala H. Al-Rabeh
Dean, College of Graduate Studies

Date: 22-6-96

DEDICATION

This thesis is dedicated to my mother and father.

ACKNOWLEDGMENT

Thanks to God for mercy and guidance.

I wish to express my respect and appreciation to my adviser, Dr. Ali A. Shash for his guidance and support which he has provided throughout the years of our association. I also would like to express appreciation and gratitude to the members of the thesis committee Dr. S.A. Assaf, Dr. A.A. Bubshait, and Dr. F.A. Al-Said for their constructive suggestions and support.

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THESIS ABSTRACT

FULL NAME OF STUDENT	:	**Saleh Abdulrahman Al-Thunaian**
TITLE OF STUDY	:	**Cost Estimation Practice for Buildings by Architectural/ Engineering Firms in the Eastern Province, Saudi Arabia**
MAJOR FIELD	:	**Construction Engineering and Management**
DATE OF DEGREE	:	**June, 1996**

This research addresses the practice of building cost estimation in the Architectural/Engineering (A/E) firms located in Eastern Province, Saudi Arabia. It explored the extent to which local (A/E) firms carry out the practice of cost estimation along different phases of building projects development. The study addresses the types of cost estimates that (A/E) firms develop for their clients, the procedures followed in preparing these cost estimates and the assessment of (A/E) project managers of the effectiveness of these cost estimates and their recommendations on ways to improve the present cost estimation system.

A pre-established preliminary questionnaires were mailed to all (A/E) firms operating in the Eastern Province, Saudi Arabia in order to solicit their interest in particiapting in the study and to determine their conformance to the study criteria. The (A/E) firms who expressed their interest to participate in the study and exhibited their conformance to the study criteria were provided with the main questionnaires which were designed to solicit needed information for this study.

Some of the (A/E) firms in Saudi Arabia provide cost estimation as part of their engineering and consultancy services. They develop all different types of cost estimates such as feasibility, budget and design estimates. They provide cost estimation services along with supervision for most of the projects and for most of the major clients such as public, Saudi Aramco, SABIC, SCECO, etc. The cost estimation procedures used are manually developed and, therefore, are labor intensive, costly, with inconsistent results and hard to check and update. However, when the results of these procedures were compared with bid prices, good results were obtained.

MASTER OF SCIENCE DEGREE
KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
DHAHRAN, SAUDI ARABIA
JUNE, 1996

خلاصة الرسالة

أسم الطالب: صالح عبد الرحمن محمد الثنيان

عنوان الرسالة: ممارسة تقادير التكلفة للمباني من قبل المكاتب الهندسية في المنطقة الشرقية من المملكة العربية السعودية

التخصص: هندسة و إدارة التشييد

تاريخ الشهادة: محرم ١٤١٧هـ

هذه الرسالة تبحث في ممارسة تقادير التكلفة للمباني من قبل المكاتب المحلية و مدى ممارسة هذه المكاتب لتقادير التكلفة عبر المراحل المختلفة من مشاريع المباني. كما تبحث هذه الرسالة في أنواع تقادير التكلفة التي تقوم بها المكاتب الهندسية لعملائها و طرق تنفيذها و كذلك التقييم من قبل مدراء المشاريع في هذه المكاتب لفاعلية تقادير التكلفة و توصياتهم للطرق الواجب إتباعها من أجل تحسين نظام تقادير التكلفة القائم الآن.

و قد تم إرسال إستبيان أولي عن طريق البريد الى جميع المكاتب الهندسية العاملة في المنطقة الشرقية من المملكة العربية السعودية حول مدى إستعدادهم للمشاركة في هذه الدراسة و التأكد من أن متطلبات هذه الدراسة تنطبق عليهم. لقد زودت المكاتب الهندسية التي أبدت إستعدادها وانطبقت عليها متطلبات هذه الرسالة بالإستبيان النهائي و ذلك للحصول على المعلومات المطلوبة لهذا البحث.

لقد وجد من خلال هذه الدراسة أن بعض المكاتب الهندسية تقدم خدمة تقادير التكلفة كجزء من خدماتهم الهندسية و الإستشارية. كما إنهم يقومون بإعداد مختلف أنواع تقادير التكلفة مثل تقادير تكلفة الدراسة المبدئية، تقادير تكلفة الميزانية و تقادير تكلفة المرحلة النهائية من التصميم. وتقوم هذه المكاتب بتقديم خدمات تقادير التكلفة و الإشراف على مختلف المشاريع و لمعظم العملاء الرئيسين مثل القطاع العام، أرامكو السعودية، سابك، سكيكو و غيرهم.

و تنهج هذه المكاتب نهجا يدويا في عملها لتقادير التكلفة و نتيجة لذلك فهي تحتاج الى عمالة مكثفة، مكلفة، غير ثابتة النتائج وصعبة المتابعة و التصحيح. و لكن عندما قورنت نتائج تلك الطرق مع نتائج العطاءات المقدمة فإنه تبين أن النتائج كانت مشجعة.

درجة الماجستير في العلوم

جامعة الملك فهد للبترول و المعادن

الظهران، المملكة العربية السعودية

يونيو ١٩٩٦

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CHAPTER ONE

INTRODUCTION

1.1 GENERAL

Architectural/Engineering (A/E) firms are organizations that offer different engineering and construction support services to public, semi-public, and private sectors in exchange for fees. They were established in Europe and U.S.A. to fulfill the need for technological development triggered by the industrial revolution towards the middle of the nineteenth century. They have been growing ever since in a fast pace and in a fashion that reflected the economical and social trends which influenced their rules and regulations. Toward the second half of the twentieth century, these rules and regulations have been adjusted as those firms decided to offer their services worldwide (Al-Musallami, 1992, Swinburne, 1980).

The need for (A/E) firms in Saudi Arabia only began during the early sixties and after the discovery of oil in commercial quantities. At that time, major international (A/E) firms established branches for their organizations and participated in offering engineering and construction services for oil and construction companies. Although the construction era has been slowing down, these (A/E) firms has continued to operate with most of them under the name of Saudi partners (Aramco, 1980).

The evolution of national (A/E) firms coincided with the huge growth rate in construction which aimed at building the country's infrastructure.

The (A/E) firms had little to offer due to the complexity and huge in size of the projects undertaken and due to the lack of experience and expertise that these (A/E) firms had (Looney, 1982).

In the beginning of the last decade, Saudi (A/E) firms with some of them still partnering with international firms started to claim their share of the market by participating and fully undertaking sizable projects (Al-Musallami, 1992).

(A/E) offices render design and many other services such as feasibility studies, construction management, etc. Cost estimating is a primary ingredient for any (A/E) firm's standard services.

Cost estimating procedure is a process undertaken by (A/E) firms to develop cost estimate of a project from available information. The procedure varies in its extensivity and complexity depending on what stage the project is on and, hence, what information available about the project structural constituents and the project characteristics (Shash and Al-Khaldi, 1992). The project information and characteristics get clearer as the project development advances along its traditional stages which include feasibility study, preliminary and detailed engineering, contract development and bid cycle, and construction (Adrian, 1982).

For (A/E) firms, cost estimation is considered the task that guarantees success, if done properly, or failure if done casually. The failure may not only affect the present project but could drive the organization involved out of business (Shash and Khaldi, 1992). The (A/E) firms may prepare

cost estimates at various stages of a project development. Every stage shares the importance to the success of the project in hand and the business in general. First, the (A/E) firm may prepare cost estimates for an owner at the feasibility study stage to determine the success and the financial return of his investment. Secondly, the (A/E) firm may prepare cost estimate during the preliminary and final engineering so they will be able to quantify the resources required to execute the work involved and, accordingly, determine the methods that the project will be financed. Also, owners and the Architect/Engineer (A/E) will use the estimate, performed during the preliminary and final engineering, as a measure to evaluate the bids submitted by interested construction contractors (Adrian, 1982).

1.2 STATEMENT OF THE PROBLEM

At times, when money financing is not easy and due to increasing cost of labor, materials, overhead, and other services, owners are faced with the necessity of having to have cost estimators who are ready to support them in every phase of the project (Al-Dulaijan, 1987). On the other hand, due to the stagnation in the development of construction projects as a result of economic stabilization and due to the owners' desire to explore different building systems, materials, and methods, (A/E) firms find it necessary to form estimating groups that develop all kinds of cost estimates for clients. They realized that these estimates need to be sound and consistent in order to maintain good reputation (Looney, 1982).

Inaccuracies in cost estimation can cause both the owner and the(A/E) firms unlimited number of difficulties. Overestimating of cost estimation may cause the owner, when he has the money, to spend extra amounts of it for no reasons where it can be better spent on other beneficial matters. In addition, an inflated cost estimate may cause the owner to reconsider the scope of the project especially if he is not convinced that the cost estimate justifies the benefits that will be expected to be received (Fisk, 1988). Finally, an overestimated cost estimate may discourage financing institutions from lending the required amount of money due to doubts regarding the cost versus benefits of the project (AlDulaijan, 1987).

Underestimating of cost estimates may lead the owner and the(A/E) firms to even more problems. They tend to deceive both parties and cause them, especially the owner, to be liberal in developing the project scope and at the end being unable to proceed with completing the project or having to down scope it in order to complete it (Adrian, 1982).

The type of problems that (A/E) firms face when developing inaccurate cost estimate is the lack of trust and all associated problems that come as a result of it. A one time development of an inaccurate cost estimate may drive the (A/E) firms out of business or at least bring sufferings for years to come as a result of slow business (Shash and Al-Khaldi, 1992).

Considering the importance of cost estimating to(A/E) firms in Saudi Arabia, it seems that researchers have not paid adequate attention to its

procedures. The following are general questions that this research is designed to address:

1 Is cost estimation practiced by (A/E) firms in the Eastern Province, Saudi Arabia?

2 What types of Cost Estimates do (A/E) firms in the Eastern Province, Saudi Arabia prepare for construction projects?

3. What are the procedures that are followed in preparing each type of Estimate?

4. How do (A/E) managers assess the methods used?

1.3 STUDY OBJECTIVES

The objectives of this research are to explore the existence, types, and procedures of cost estimation practices for building project undertaken by (A/E) firms in the Eastern Province, Saudi Arabia. Moreover, this research is intended to solicit the assessment of (A/E) firms' project managers of the methods of cost estimation systems currently used at different stages of the project process.

1.4 SIGNIFICANCE OF THE STUDY

There are many groups inside and outside the construction industry who will be benefited from this study. Among these groups are: owners, project management organizations, construction contractors, and academicians. Some of the benefits that this study offers include:

1. Orient the different groups in the construction industry of the existence and the scope of cost estimation practices in the (A/E) firms.

2. Indicate the satisfaction of the (A/E) firms' project managers which, in turn, highlight the size of improvement needed to the current cost estimation systems.

3. Encourage project management organizations and contractor to participate in the development of cost estimation systems using their expertise and knowledge of construction materials, methods, and process. This can be achieved by circulating the results of this research and soliciting their input in order to be used in future researches.

4. Provide areas for research for academicians who may elect to study areas where improvements can be made.

5. Provide possible improvement of (A/E) Cost Estimating System and its benefits to owners, (A/E) firms and the constructor of the project.

1.5 SCOPE AND LIMITATIONS

This study is limited to (A/E) firms operating in the Eastern Province of Saudi Arabia. The study is also limited to designed and supervised building projects undertaken during the last 5 years.

CHAPTER TWO

LITERATURE REVIEW

2.1 COST ESTIMATION

2.1.1 Introduction

Cost estimation is defined as the best judgment of what project will ultimately cost (Collier, 1987). It is normally based on information derived from specific contract documents which are comprised of set of drawings, related specifications, a contract, knowledge from past experience, and data from completed projects. The compliance of the project estimated cost compared with the actual cost solely depends on the skills and proper judgment of the estimator since the cost estimate is always developed prior to the work commencement. The skill is defined as the correct utilization of appropriate estimating methods and the proper judgment is defined as the sound comprehension of the work in the form it will be undertaken (Raddon, 1982).

Construction cost estimations have many types and are developed for so many different purposes and by utilizing different methods. As a result, the outcome provides different results. Some of these methods are moderately simple and sufficiently useful for the purpose intended for. Others, on the other hand, are relatively sophisticated and require more time. Factors such as the purpose of the cost estimate, the amount of information required by the system, the level of accuracy required by the estimator, the

time allowed for the development of the cost estimate all dictate the cost estimate method to be followed (Hubbard, 1987).

There are normally four different parties involved in the different phases of a construction project. They are the owner, the architect/engineer, the construction (general) contractor, and, sometimes, the financing agency. The time of involvement of each party differs at the project cycle and is different from one project to another depending on the predetermined organizational function. Each party has an obligation to provide some sort of cost estimation along various stages of the project. In the early stage of the project during the development of the project scope, the owner needs to know the approximate cost for budgeting and planning purposes. Later, the architectural engineer develops cost estimates for different design alternatives in order to select the appropriate one that meets the owner's budget and required operational requirements of the project (Shash, 1993). The construction contractor must determine the cost estimate required to undertake all work in strict conformance to all contract documents. This cost estimate along with the addition of some allowances totals to the contractor's bid price of the project. Finally, financing agencies develop approximate cost estimate of a project independently from other parties in order to determine the cost and return on investment and, therefore, decide potential success or failure that a project has (Collier, 1987).

The cost estimate developed by the owner is different in form, technique, or function from those developed by the architect engineer or

the contractor. The owner's cost estimate is normally developed for feasibility study and financing purposes should the owner be of a private entity. Should the owner be of public entity, on the other hand, such as providing sources with potential return, the cost estimate is developed for budgeting and funding purposes. Both types of owners exercise some type of control such as selection of alternative design proposals and cost control during the design phase (Lewis, 1978).

2.1.2 Types of Cost Estimations

Every construction project is required to have several types of cost estimates prepared for it. The type and size of the project dictate the degree of details that these estimates have. The feasibility estimate is developed once the owner sets up his requirements of the proposed project which include all major constituents and criteria of the project. Conceptual estimate, normally developed by an (A/E) firms, is developed after a conceptual plan is developed for the project. Methods of cost approximation such as parameter, range, or factor estimate is used in developing conceptual cost estimate. Detailed cost estimates are developed by contractors who are interested to bid a certain job. They include detailed breakdown of activities and materials and give considerations to factors affecting the project cost and market conditions (Adrian, 1982).

During the construction process, the contractors and subcontractors prepare progress estimates for interim payments and, also, prepare study and change order estimates should alternative methods of construction are

considered. Finally, final estimates are developed to determine final payments for contractors (Fisk, 1988).

2.1.2.1 Feasibility Estimate and Its Importance

No matter what the reasons behind the development of a certain project are, they include both benefits and costs. Systems were created in order to measure these benefits and costs which ultimately give the signal for proceeding with the development of the project or not. When costs and benefits are measured and compared, this practice is called feasibility estimate. Although this estimate is widely known as the owner's estimate, it is commonly developed by an (A/E) firm (Adrian, 1982). The documentation of the project at this stage in terms of the exact project constituents and requirements are not available except a brief write up that explains the overall objectives of the project and the limitations, if any, on it. It is extremely important for the (A/E) to correctly predict the benefits that the project is claimed to offer. Similarly, all risk factors need to be properly anticipated and evaluated. Not being able to do so, the feasibility estimate is considered worthless (Adrian, 1982).

2.1.2.2 Preliminary Estimate and Its Importance

This estimate is normally developed during the design stage of the project. It is developed as the design of the project progresses. Therefore, it is updated frequently by the same (A/E) who is contracted to develop the project design (Swinburne, 1980). Preliminary estimate is developed using the feasibility estimate as a basis. Its main objective is to evaluate the

impact of developing factors on the cost of the project. Such factors are new requirements set by the owner, the clarity of project constituents and criteria, and the owner intent to seek different designs. The preliminary estimate is considered accurate for practical purposes although it is developed without the availability of detailed drawings and the non-availability of information regarding construction methods. Due to the complexity of the process of construction projects and its associated increasing costs which made it difficult on owners to acquire the required funding, there has been an emphasis on developing an accurate preliminary estimate. Moreover, the increasing trend towards using fast track and phased construction process dictates the importance of developing more accurate preliminary estimates (Adrian, 1982).

2.1.2.3 Detailed Estimate and Its Importance

The previous two sections discussed the development of what can be identified as pre-construction cost estimates. They are considered the owner/ architect engineer cost estimates. While the previous two are essential for the success of the project, the detailed cost estimate is just as important especially for the general contractor. It usually represents more than 85% of the total project cost (Swinburne, 1980). It is the detailed cost estimates that dictates the amount of profit or loss that the construction contractor will obtain at the completion of the construction process. It is rarely that one construction contractor will undertake the project construction in its entirety. Instead, few contractors along with the main (general) contractor will share the undertaking of the project construction.

They are normally called subcontractors who specialize in certain aspects of constructions. During the bidding process, subcontractors will prepare the cost estimate of their part of the work which will be added to the general contractor's estimate comprising the construction cost of the project (Swinburne, 1980).

2.1.3 Construction in Saudi Arabia

As a society of only a few decades, Saudi Arabia accomplished rapid development during a period that took other societies three or four times as much. During the last twenty years, the Kingdom has developed through the biggest unanticipated construction boom ever experienced. During the National Development Plans, the construction industry has been the biggest of government spending (Salamah, 1989).

The construction industry worldwide is the biggest non-petroleum industry and is considered to be an indicator of the shape of national economy. The construction industry in Saudi Arabia employed about 25% of the labor force to undertake all kinds of projects such as building projects, heavy and highway projects, and industrial projects. Building projects is partially funded by private sector and consists of residential and non-residential projects. Residential projects are normally constructed with permissions from local municipalities. It follows local building codes and regulations. Non-residential projects include commercial construction such as office buildings, shopping centers, schools, hospitals, and mosques. It

represents the same amount of construction that the residential projects has (Salamah, 1989).

Heavy and highway projects, on the other hand, include dams, tunnels, highways, airports, sea ports, and others. It represents a larger share of total construction funds than that of building projects and are always funded by the government. Industrial projects, which include refineries, factories, power plants, and desalination plants constitute approximately the same size of construction that the heavy and highway projects has. Industrial projects are always funded by the government (Lewis, 1978).

Throughout its development, Saudi Arabia has four major developmental periods. The First Period which ended in 1950 witnessed the development of construction projects which were characterized to be small in size and had no technological aspects of construction. The Second Period which elapsed from 1950's to 1960's is characterized by the introduction of a large increase of construction projects. It was solely dedicated to build government facilities in Riyadh. Construction projects included office buildings for ministries, hospitals, schools, and basic infrastructural facilities such as water, power, roads, and small airports. All projects were funded by the government. The third period which covered from 1960's to 1970's was called the "Petro-Dollar Construction Age". The projects constructed during this period were considered the biggest worldwide. Construction projects included housing projects, airports, seaports, power and desalination plants, shopping centers, schools, hospitals, and streets and traffic systems. Spending was triggered by the availability of cash flow

with the government and private sector and, therefore, resulted in fast construction. Low quality of construction and inflated costs were evident due to lack of priorities and code control (Shash and Al-Khaldi, 1992).

The Fourth Period which began in the early eighties was characterized by the starting of long-range planning. Due to the shortage in construction funds to build new projects and due to the lack of quality in previously constructed projects, maintenance projects and surplus of locally produced building materials were evident. In addition, surpluses in vacant residential buildings, shops, and office buildings began to resurface (Madani, 1987).

2.1.4 Cost Estimation in Saudi Arabia

As mentioned in the previous section, the construction industry was the prime recipient of the government spending during the First and Second National Development Plans. As a result, owners and construction contractors need to do a systematic and conservative cost estimating procedure. It was common that owners decided to invest in new projects without developing studies to determine whether the projects will be successful or not. Similarly, contractors used to submit inflated bids for project construction that no matter how much risk involved, the contractor will always end up with handsome profit. Presently, due to the present conservatism in undertaking projects, owners and contractors are confronted with the difficulty of producing cost estimates for their projects due to the non-availability of an adopted quality cost estimating procedure. Nevertheless, the project development goes through specific phases where

project objectives and cost estimates are identified carefully (Shash, 1993). First, the owner will hire a consultant to develop a feasibility study for the project which normally includes but not limited to market survey, technical study, project financing, and project economic analysis. The fund for this phase is usually small, ranges from 2 to 3 percent of the project cost value. The approaches that was adopted in determining the project cost at this stage are unit cost, parameter, factor and/or range estimates. The accuracy of these types of estimates ranges from 15 to 25 percent of the actual cost of the project depending on the integrity of feasibility study and the project characteristics. Second, if the project is determined to be technically and commercially feasible and fundable, the owner will proceed with hiring another design consultant to carry out the preliminary and detailed engineering which is sometimes considered two stages, preliminary engineering and final or detailed engineering stages. The approximate cost of each of these two stages are 3 to 5 percent of the total cost of the project (Hubbard, 1981).

Among the duties of the design consultant at this stage is to develop a project cost estimate for the owner in order to confirm that the project cost is within the owner's budget and no hidden cost existed without being accounted for. The estimating methods that are used at this stage are similar to that used during the feasibility study and the cost ranges from 5 to 10 percent of the actual project cost. Finally, the owner will bid the project openly or selectively, depending on whether being from government or public organization. The successful bidder, based on the

detailed design package and the contract document, is expected to account for the nuts and bolts of the project constituents and characteristics. The contractor's cost estimate includes accounting for material costs, direct and indirect manpower costs, equipment costs, subcontractor cost, company and project overhead costs, and profit (Shash and Al-Khaldi, 1992)

2.2 (A/E) OFFICES

2.2.1 Introduction

The practice of Architect/Engineer (A/E) has drastically changed since World War II which imposed the design and production of more and more effective weapons and hardware for support services. The majority of (A/E's) had an education which was limited to what general public required such as design, drafting and general knowledge of construction. The past education had overlooked qualifying the (A/E) to deal with financing, cost estimation, cost control, value engineering, etc. The evolution of such practices such as value engineering and due to the stiff competition between (A/E's) to provide services that meet the owners requirements and are cost effective triggered (A/Es) to be familiar with such services. Accordingly, the (A/E) is increasingly expected to provide more than design work and, instead, be familiar with providing cost effective product. Therefore, the (A/E) started to be involved in the feasibility of construction at particular site and time, the purchase of the property, the construction cost, leasing, and financing. The owner who requires more than design services will appreciate an (A/E) who has other support services such as value

engineering, aesthetic value of the building, and is conscious of building cost. The (A/E) is considered to be as a master builder because of the familiarity of such support services. Some (A/E) offices have included a few people in its staff who have expertise in the related fields. Some have hired consultants who may be called upon when required. Others have structured complete department to undertake support services and may even have joint venture should other knowledge is required (Lewis, 1978).

2.2.2 Architect/Engineer (A/E) Practices

The American Institute of Architects (AIA) classified professional engineering services into six divisions. These divisions included the basic services of design and planning in addition to other five related services. The six divisions are as follows:

1. Project Analysis Services
2. Promotional Services
3. Design and Planning Services
4. Construction Services
5. Supporting Services
6. Related Services.

1. Project Analysis Services

Recently, the (A/Es) have been asked to provide services that are not design services, but rather to assist the owner as well as the (A/E). These services are related to the feasibility of the project. The (A/E), in this case, is seen as the agent of the owner. The feasibility of the Project is very important. Considerations such as the need for the facility, the economic requirements, location, legal requirements, and personnel available to operate the facilities are all vital issues that have to be addressed prior to the design of the project. The site analysis in terms of the relationship of the site to transportation, raw materials, working labor, and market are of vital importance to be analyzed carefully.

The facility program and the operational sequence within the facility are related to the design and are often considered as a basic service. The sizes of the rooms and working spaces inside a facility, their uses, special finishes, and the relationship to each other must all be developed by the (A/E) (Lewis, 1978).

2. Promotional Services

These services seem to be self-serving services for the (A/E) and often be the difference between undertaking a specific project or losing it. The (A/E) is often required to provide presentations to different interest groups such as city officials, environmental, the financing agencies and others to promote the prospects of the project. A comprehensive knowledge not only

about the project but also about the surrounding areas, the future role of the facility with respect to existing locality is essential for the (A/E) to be oriented about should the promotion role be a successful one.

3. Design and Planning Services

These services are normally considered as part of the (A/E) basic services. It is subdivided into operational design and building design. The operational design may either be maintained as previously developed or may be revised or altered as the owner may feel necessary. The building design is a planning problem and at later stage becomes as a communications problem. The design and planning may be divided into seven parts that were recommended by the (A/E):

1. Schematic design
2. Preliminary estimates
3. Design development
4. Outline specifications
5. Cost analysis
6. Working drawings
7. Final specifications

The (A/E) should communicate with the owners representatives information of how the operation of the project should be. The (A/E) should continue during the process of the project development to provide

preliminary cost estimate in order to avoid designing a facility for the owner that will exceed the available fund. The (A/E) should be able to provide construction documents and field observation of construction at the end of this stage of service (Lewis, 1978).

4. Construction Services

These services are considered as a support services although some consider it as part of the basic services. Some examples of these services are bids and construction contracts, supervision and administration, job cost accounting, construction management, and post-construction services. Construction services are normally categorized into three major categories: (1) Full inclusion as a part of basic services. In this case, the (A/E) continues his participation to provide documents, field observation, cost accounting and other related work until the job is completed. (2) No construction services included. In this case, the normal construction services is undertaken by the owner staff. The (A/E) may be called for to provide interpretation of the design documents. (3) Only construction services included. This case became a practice in the last few years. The (A/E), in this case, manages and supervises the construction of the project that was designed by another (A/E) (Salamah, 1989).

5. Supporting Services

Some of these services are considered part of the basic services such as providing site plans, landscape work, interiors and furnishing, art work, acoustics, food services, lighting and communication systems. Others such

as marketing of products or merchandising of finished product are not considered as part of the basic services for an (A/E). All the two types of the supporting services are specialized activities and cannot be handled by an average practicing (A/E).

6. Related Services

The (A/E) considered the following items as related services:

1. Education Consultation
2. Industrial Consultation
3. Research and Testing
4. Products Design
5. Architectural Graphics
6. Prefabrication Processes

The degree of specialty may vary considerably between (A/E) in one of these services or from one service to another (Lewis, 1978).

2.2.3 Architect/Engineer (A/E) Practice in Saudi Arabia

The availability of literature which provides an orientation of the(A/E) practice in Saudi Arabia is very limited.

The (A/E) firms in the Kingdom consists of foreign and local firms. Most of the large size (A/E) offices are collaborating with international firms that provides different consultancy services for the sake of large or

highly specialized projects. The contractual relationship between the (A/E) firm and the client is spelled out without elaboration on the scope of potential occurrences. The agreement is considered a routine one and there is trust in case of potential conflict. When a contract is written, only few provisions are covered by the agreement. These provisions are fee, scope, duration, payment schedule, and supervision. There is no rule governing the right to use the contract documents (Shash and Al-Ghannam, 1992).

The design fee that the (A/E) receives takes a lot of forms depending on the size of the project to be designed and the types of services delivered other than the basic design services. Generally, the fee may be broken into several constituents. First, direct cost that covers the cost of engineers, securing legal permits, and cost of materials. Second, overhead cost which includes the cost of all indirect charges for the design of the project and is necessary for the operation of the design offices.

The (A/E) firms price their work in different ways. Among these are lump sum, percent of the project cost, and the cost plus a fee. The lump sum fee is a fixed amount paid to the (A/E) firm in one time payment or in milestone payments.

The percent of the project cost makes the (A/E) firm eligible for a predetermined percentage of the project construction cost. In this type of compensation, the owner and the (A/E) agree on the percentage when the agreement is developed. The last type of compensation, cost plus fee, mandate the owner to pay the (A/E) firm for all cost spent on the

development of the contract documents plus a service fee. The fee can be either a fixed fee or a percentage of the cost (AlMusallami, 1992).

The (A/E) has several ways to determine its design fee. It can specify the fee as a lump sum at the time of agreement discussion with the owner; can determine the fee as a function of engineering hours; can determine the fee in accordance with the three phases of the design development, or can negotiate the fee percentage during the agreement negotiation.

Should the owner wishes to use the design documents on another project, the revised fee is negotiated. It is considered a new business deal rather than a continuation of the previous design contract. The American Institute of Architects (AIA) states that the project documents, whether used or not, are the property of the architect. The AIA limits the right of the owner to keep few copies of the project documents for the purpose of "information and reference in connection with the owner's use and occupancy of the project" (AIA Manual, 1978).

The ownership of the design document in Saudi Arabia is defined for governmental projects. The ownership of the design documents of privately owned project is never defined by local laws (Shash and Al-Ghannam, 1992).

2.3 COST ESTIMATION BY (A/E) FIRMS

2.3.1 General

In order for the cost of designed project not to exceed the owner's budget, the (A/E) repeatedly estimates the project at every stage of the design phase. Only large (A/E) firms have in-house cost estimators. Otherwise, consultants are normally used. They are well familiar with the cost of local market materials and labor costs. The competent consultant can provide sound estimate even at the preliminary stage due to its ability to provide good idea of project cost.

The (A/E) firms who exercise the development of project preliminary estimate are required to have individuals who are knowledgeable with construction materials, fully understand building designs, familiar with construction trades, able to understand design details, and being familiar and able to predict construction labor productivity (Al-Musallami, 1992). When the preliminary estimates are developed, it is hoped to be used as a check and as an upgrade of feasibility estimate. Moreover, it helps the (A/E) in designing to certain budget and establishing and acquiring of the owner's funding. Furthermore, it assists in evaluating contractors' bids. Finally, it is used as a basis for determining the contractor's progress payments (Adrian, 1980).

2.3.2 Cost Estimation by (A/E) Firms in Saudi Arabia

Due to the significance of this section in terms of being an introduction to the research and in terms of being the basis to frame our study around it, an extensive effort was conducted in order to find literature written about this subject. Unfortunately, no study has been made yet on this subject.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 GENERAL

This chapter presents the steps that were followed to achieve the objectives set for this study. It includes the description of all required data, data collection, and sample selection from which information obtained. Finally, the method by which the data were analyzed is presented.

3.2 REQUIRED DATA

The study's objectives necessitated the collection of information for various variables. These are defined here to provide common understanding of how they are commonly used.

These definitions were provided to participating (A/E) firms along with the main questionnaire in order to insure mutual understanding with participants of the usage of such terms.

Cost Estimation: The technique that is followed in order to determine the amount in monetary terms necessary to undertake an activity. The determination accounts for materials, labor, equipment, and many other variables that affect conducting that activity. For the sake of this research, cost estimation will refer only to building construction cost.

Cost Estimation System: The process by which the cost estimate of a project is developed in terms of the sequence when the task is received by the chief estimator until it is submitted back to the design manager.

Feasibility Estimate: The estimate developed as part of a feasibility study to determine whether the project can be built to meet the owner set criteria.

Preliminary (Conceptual) Estimate: The estimate developed as part of the project conceptual plan to set an approximate cost for the project. It is considered more sound than feasibility estimate and cost estimation methods such as range estimate, factor estimate, and parameter estimate are used.

Detailed Estimate: The estimate developed for bidding purposes. It involves the development of quantity take-off, labor cost, equipment cost, and other cost affecting parameters. The owner may elect to develop it in order to be able to compare and analyze bids.

Progress Estimate: The estimate developed for contractors payment purposes. It is developed based on the construction progress and payment provisions in the contract.

Final Estimate: The estimate developed to determine the final payment for the contractor. It involves the impact of change orders, penalties, and incentives.

***Cost Parameters*:** Factors that affect cost estimates such as client, weather, site conditions, location, etc. These factors are evaluated carefully due to their impact on the final cost figure.

Cost Trending: The rate at which a cost estimate is inflated with time to account for market conditions such as inflation, value of money, and the number of years before which the project will not be constructed.

Cash Budgeting: The forecasting of cash receipts and cash disbursements and the expected time at which these receipts and disbursements take place.

Construction Prorates: An allowance applied to construction cost to allow for construction complexity and special safety and security requirements.

Cost Control: The process by which the project progress and cost is documented and monitored. The control of labor and material cost can be carried out by documenting material quantities and labor hours.

Project Management: An organization that monitors construction and construction related activities in a project. Among these activities are design process, contract procurement, planning and scheduling and commissioning.

Productivity: The measure of work quantity executed as compared to time necessary to carry out that work.

Construction Methods: The means by which construction can be executed. Equipment plays an important role in the execution of construction method.

Quality Control: The process performed that involves construction inspection and type of material and workmanship to insure that the work constructed meets the requirements of the drawings and specifications.

Value Engineering: A technique followed to reduce the total construction cost by offering different system alternatives that offer the same function without sacrificing the quality and integrity of the system.

Constructibility Reviews: Reviews performed on design packages to ensure that the design meets operation and maintenance requirements.

Life Cycle Costing: A technique that is followed separately or as part of value engineering study to determine the cost of a project from the design stage through construction stage and finally during operation stage.

3.3 DATA COLLECTION

3.3.1 Source of Data

The data needed for this research was solicited from designated key informant in 18 (A/E) firms. These (A/E) firms are those which expressed their interest in participating in this study and, at the same time, demonstrated their conformance to the study criteria. The key informants were selected on the basis of their familiarity with the cost estimating

process in their firms. Their positions varied from executive managers, through design and project managers and to estimating supervisors and project engineers.

3.3.2 Tools for Collecting Information

The needed information was collected by using two set of questionnaires. The first, designated as preliminary, was mailed to all(A/E) firms operating in the Eastern Province, Saudi Arabia. This questionnaire was designed to identify (A/E) firms that meet the study criteria which includes developing cost estimates for designed and supervised building projects during the last five years.

The second questionnaire, named main questionnaire, was designed to acquire various types of information from (A/E) firms in order to help formulating ideas of how (A/E) firms provide cost estimating services. It was mailed to qualified (A/E) firms who met the research criteria set by the preliminary questionnaire. Preliminary and main questionnaires are shown in Appendix II. The main questionnaire, shown in Figure 3.1, is subdivided into:

A. Organization Structure:

This part is concerned with information about the size of manpower, size of projects undertaken, nature of clients, and the type of projects carried out in terms of project structures.

B. Cost Estimating Department:

This part is concerned with whether the (A/E) firm has an estimating unit or not. Should there be one, information such as the size of the group, years of experience of estimators, level of education and whether the group members are dedicated only to provide cost estimation services or not will be acquired.

C. Function of Cost Estimating Department:

The purpose of this part is to acquire information regarding the types of cost estimation that are developed by the cost estimating group including feasibility estimates, preliminary estimates, detailed estimates, etc.

D. Feasibility Cost Estimating Procedures:

This section addresses the process that is followed once the owner requests a feasibility cost estimate until it is ready for submission to the owner. In addition, cost information along with cost affecting parameters are outlined and evaluated. Finally, the characteristics of the feasibility cost estimates are evaluated in terms of the satisfaction of the (A/E) firm with them.

E. Budget Cost Estimating Procedures:

This part is similar to that process followed in the previous section, D, but for budget cost estimating procedures. It requires the same type of

information in terms of the level of importance and the respondent satisfaction with it.

F. Design Cost Estimating Procedures:

This section is similar to that in Section D and E, but for Design Cost estimating procedures.

G. Other Cost Estimating Procedures:

This part is planned similar to Sections D, E, and F, but for other cost estimating procedures with special nature that the (A/E) firm practices.

3.3.3 Population

The preliminary questionnaire was mailed to all 153 (A/E) firms located in the Eastern Province, Saudi Arabia to identify those (A/E) firms that provide project cost estimation to designed and supervised building projects during the last five years. Only 78 (A/E) firms responded to the preliminary questionnaire. However, the (A/E) firms which demonstrated that they conform to the study criteria are 39. Those (A/E) firms were considered as the population size. Since the population size is small, the main questionnaires were mailed to all (A/E) firms in the population. See Figure 3.2.

SECTION: A

(A/E) FIRM (ORG.), EXP., OFFICES, T/O, SIZE, TYPES OF PROJ., CATEGORY, CLIENTS, ETC

SECTION: B

EST. DEPT., STAFF, EXP. EDUCATION, NATION, EXIST., NAME

LOCATION

SECTION: C

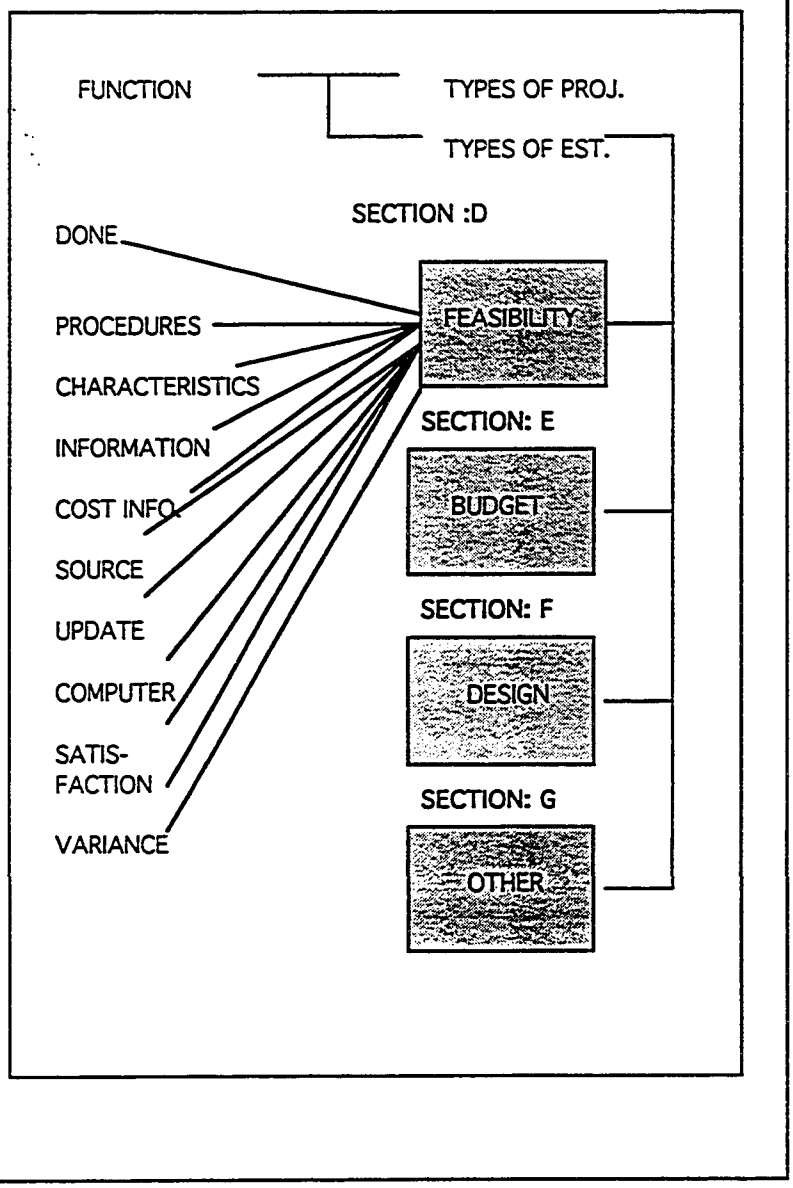


Figure 3.1: The Outline of Main Questionnaire

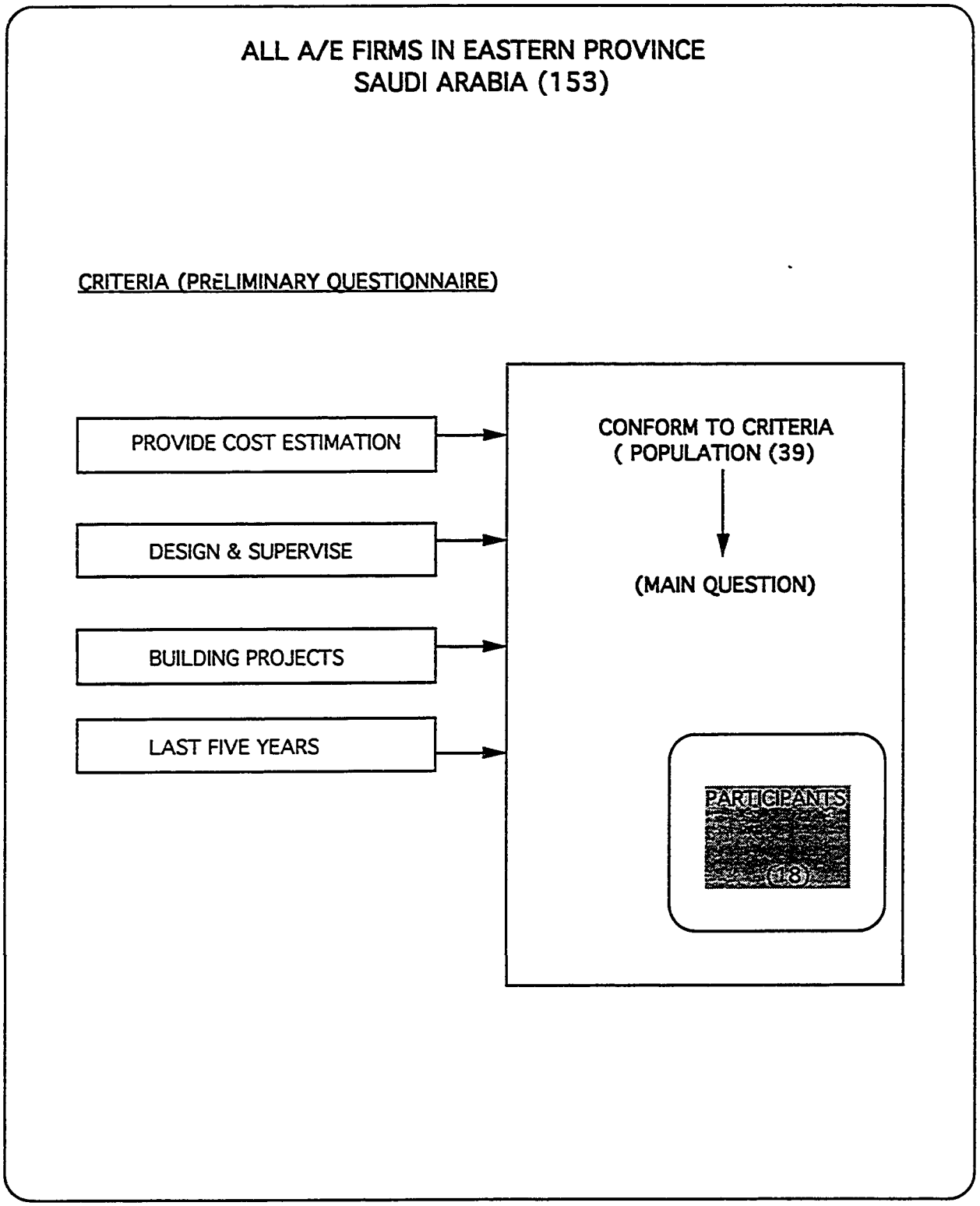


Figure 3.2: Definition of Population

3.4 DATA ANALYSIS

The data solicited from respondents were analyzed using simple statistical procedures and Qualitative Data Analysis.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents an analysis for the information obtained from (A/E) firms. It, also, contains the findings of this research regarding the construction cost estimation practice conducted by (A/E) firms in the Eastern Province of Saudi Arabia. Obtaining the information on the main questionnaire often involves interviews and frequent telephone conversation. From the 153 (A/E) firms that were asked to participate through the preliminary questionnaire, only 39 respondents exhibited their conformance to the criteria and their interest to participate. However, when the main questionnaires were mailed, only 18 responded despite continuing persuasion.

The number of respondents to the main questionnaire includes firms of large, medium, and small sizes. The way the questionnaire were completed, many seem to respond properly and precisely. Few did not provide consistent information in some parts or left some questions unanswered.

The findings presentation is exhibited in a certain way to maximize the readers' understanding and visualization of these results. It is presented in the same fashion that the main questionnaire is organized.

Throughout the course of this analysis, the participants results were exhibited to provide global view of results. However, participants will be issued identification numbers to avert disclosing of such information which some (A/E) firms may regard it as confidential information.

4.2 POPULATION DEFINITION

This section describes the process by which the elements of the population was formulated. The process started by mailing preliminary questionnaires to 153 (A/E) firms, the total number operating in the Eastern Province, Saudi Arabia. The objective of this questionnaire was to solicit the (A/E) firms' interest in participating in this study and to define (A/E) firms conforming to the study's criteria which include the involvement in project cost estimation of designed and supervised building projects during the last five years. The process of defining the (A/E) firms of the population consisted of the following steps:

1. The Preliminary questionnaire was sent to 30 randomly selected (A/E) firms. Only 2 firms responded with only one meeting the study criteria. One main questionnaire was mailed.

2. Another set of the preliminary questionnaires was also mailed to another 30 randomly selected (A/E) firms. As a result, two qualified (A/E) firms responded and they were sent questionnaires.

3. The process continued by sending increments of 30 preliminary questionnaire and mailing main questionnaires to qualified (A/E)

firms until all 153 (A/E) firms were approached. The number of responding (A/E) firms which responded to the preliminary questionnaires were 78 but those which met the study criteria and who received the main questionnaires were 39. Those qualified 39 (A/E) respondents were considered the study population. Since the population size was very small, it was decided to mail main questionnaires to all (A/E) firms in the population.

The return rate, however, was low despite the extensive efforts made to persuade (A/E) firms to participate. After a year of continuous follow up, only 18 (A/E) firms completed and returned the questionnaires representing 46% of the population.

4.3 CHARACTERISTICS OF THE KEY INFORMANT

When the preliminary questionnaire as sent to (A/E) firms, it was suggested that should they conform to the study criteria, they need to designate contact persons who have key positions and will be able to obtain all the required information. They all complied and these individuals either completed or coordinated the completion of the main questionnaires. As shown in Table 4.1, a list of contact persons positions which ranges from vice president, general manager, or owner to discipline engineers is shown. It was noticed in this study that the completeness, consistency, and precision of information improved as the level of contact person gets higher or in a project management position. It can be seen from the table that 55.5% of the respondents have key positions that ensure quality

information. In addition, the information was provided by project control engineers (16.8%) and estimating supervisor (5.5%) who are believed to provides sound information.

Table 4.1. Position of Key Informant.

Position of contact persons	Frequency	percent	Commulative frequency	Commulative percent
Owner/Vice President/Gen. Manager	5	27.8	5	27.8
Manager of Engineering	4	22.2	9	50.0
Project Manager	1	5.5	10	55.5
Project Engineer	1	5.5	11	61
Engineer (Project Control)	3	16.8	14	77.8
Engineer (Engineering)	2	11.2	16	89.00
Business Administrator	1	5.5	17	94.5
Estimating Supervisor	1	5.5	18	100

4.4 CHARACTERISTICS OF PARTICIPATING(A/E) FIRMS

This section includes information about the size and nature of different groups in one (A/E) firm. The information indicates the capacities and capabilities of the (A/E) firm which may affect the level of involvement when carrying out cost estimating or other project management activities.

4.4.1 Experience of(A/E) firms

The number of years in business along with other information is compiled and shown in Table I.1 in appendix I. It is used as a measure and indicator of experience. The experience of the participating (A/E) firms ranged from 7 to 37 years with an average of 17 years, a wide range of experience. It is evident that the participating (A/E) firms have very good experience in the engineering and consultancy business. About 27.5% of the respondents have more than 20 years of experience while the majority, 11 out of 18, has 15 years of experience or more. The experience distribution is shown in Table 4.2.

Table 4.2. Number of years in business.

Years in Business	Frequency	Percent	Commulative frequency	Commulative percent
37	1	5.5	1	5.5
30	1	5.5	2	11
23	1	5.5	3	16.5
21	1	5.5	4	22
20	1	5.5	5	27.5
18	1	5.5	6	33
16	1	5.5	7	38.5
15	4	22.2	11	60.7
14	2	11	13	71.7
13	1	5.5	14	77.2
12	2	11	16	88.2
8	1	5.5	17	94.5
7	1	5.5	18	100

4.4.2 Types of Entity of(A/E) Firms

One half of the responding (A/E) firms stated that their firms are family owned, 22.2% corporation, 16.8% self owned/sole ownership, 5.5% joint venture (Saudi - Saudi), and 5.5% partnership. The types of entities are not unique individually. Many participants responded by indicating

that their firms conform to more than one entity. For example, some firms are family owned but at the same time they are partnerships and joint ventures. Therefore, the percentages indicated in Table 4.3 and Figure 4.1 may shift from one entity to another but their dominance decreases as we go down the list.

Table 4.3. Respondent's type of entity.

Type of entity	Frequency	percent	Commulative frequency	Commulative percent
Family owned	9	50	9	50
Corporation	4	22.2	13	72.2
Selfowned/sole ownership	3	16.8	16	89
Joint venture (Saudi - Saudi)	1	5.5	17	94.5
Partnership	1	5.5	18	100

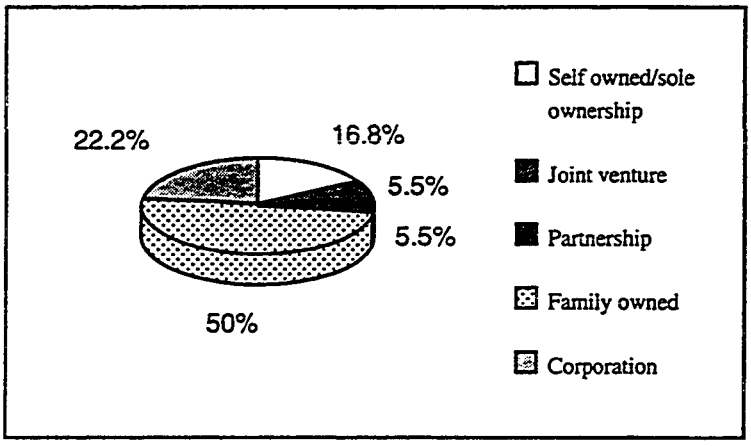


Figure 4.1. Percentage of various types of entity.

4.4.3 Number of Branch Offices

The numbers of branch offices excluding the main office for all (A/E) firms are shown in Table 4.4 along with other pertaining information. The result shows that about 27.8% of the total number of (A/E) firms has a single office in the Eastern Province, about 22.2% of the design offices have only one representation, and 50% have two or more representations.

Table 4.4. Number of Branch Offices.

Number of branch offices	Frequency	Percent	Commulative frequency	Commulative percent
0	5	27.8	5	27.8
1	4	22.2	9	50
2	4	22.2	13	72.2
3	3	16.8	16	89
4	1	5.5	17	94.5
8	1	5.5	18	100

Most of the participating (A/E) firms are operating in at least one area of operation other than the main office. From Table 4.5 and Figure 4.2, it is evident that 31.5% of the total number of branch offices are located in the Eastern Province, 26.3% are located in the Western Province, 22.8% are located in the central province, 10.5% are located in the Southern Province, and 8.9% are operating internationally.

Table 4.5. Areas of operations for participating A/E firms.

Area of operation	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Eastern Province	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	18	31.5
Western Province	x		x	x	x		x	x	x	x	x	x	x	x		x	x	x	15	26.3
Central Province	x			x	x		x	x	x	x	x	x	x		x	x	x	x	13	22.8
Southern Province	x			x					x		x			x					6	10.5
International	x								x		x		x	x					5	8.9
																			Grand Total percent	57	100

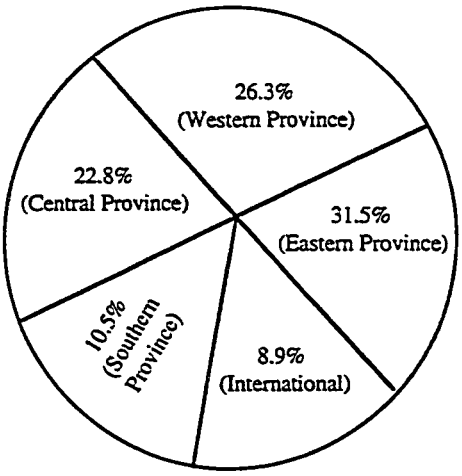


Figure 4.2. Percentage of areas of operations.

4.4.4 Number of Employees

The number of employee working in the participating (A/E) firms ranged from less than 100 to more than 800. It is evident from Table 4.6 that 72.7% of the respondents have more than 100 employees. This implies that the respondents are dominantly large (A/E) firms in terms of the size of manpower.

Table 4.6. The total number of employees that (A/E) firms have.

Range of number of employees	Frequency	Percent	Commulative frequency	Commulative percent
less than 99	6	33.3	6	33.3
100 to 199	4	22.2	10	55.5
200 to 299	2	11.1	12	66.6
300 to 399	3	16.9	15	83.5
400 to 499	0	0	15	83.5
500 to 599	0	0	15	83.5
600 to 699	1	5.5	16	89
700 to 799	1	5.5	17	94.5
800 and more	1	5.5	18	100

4.4.5 Annual Turnover

Most of the participating (A/E) firms (61.5%) had reservations regarding the disclosure of the firm's approximate annual turnover and

considered it as a restricted piece of information. Nevertheless, the information obtained from 7 (A/E) firms indicates a well distributed spectrum of annual turnovers values ranging from SR. 1 million to SR. 100 millions as shown in Table 4.7

Table 4.7. The (A/E) firms approximate annual turnovers.

Annual turnover (SR MM)	Frequency	Percent	Commulative frequency	Commulative percent
1	1	5.5	1	5.5
3	1	5.5	2	11
25	1	5.5	3	16.5
37.5	1	5.5	4	22
50	1	5.5	5	27.5
80	1	5.5	6	33
100	1	5.5	7	38.5
RI*	11	61.5	18	100

*RI denotes restricted information
N =18

4.4.6 Types of Services Rendered

The participating (A/E) firms stated that their clients include public, government and semi government agencies. From Tables 4.8 and Figure 4.3, it is evident that a big share of engineering and consultancy services were dedicated to industrial clients especially Saudi Aramco which provides 30.2% of the business, Sabic (6.5%), Royal Commission (4.5%),

and SCECO (3.4%). Other clients such as public, private business, and residential provides 18.5%, 16.1% and 18.4%, respectively.

The participants indicated that they perform all types of general engineering disciplines among their consultancy and engineering services such as architectural, mechanical, civil, chemical, and electrical engineering. In addition, some participants indicated that they are practicing some specialty engineering services such as geological services, instrumentation, surveying, and communication. From Table 4.9, it can be noted that 44.4% of the participants renders consultancy services along with other engineering services.

The participants, in general, indicated that they are participating in wide range of project types and most of them are involved in many diverse types of projects. Only few are concentrating in specialized activities. The infrastructure type of projects seems to dominate the others simply because the building projects is one of the criteria set for (A/E) firms to participate in this study. Others such as industrial projects and residential projects, are practiced by 20.3% and 22%, respectively. See Table 4.10 and Figure 4.4.

On the other hand, the projects designed and supervised by participating (A/E) firms extended through wide range of sizes as indicated in Table 4.11. and Figure 4.5. The sizes started from less than SR 5 million to more than SR 100 million worth of projects. However, most of the projects carried out (29.89%) of small values (less than SR 5 million). Through out the range, the percentage decreased gradually for the exception of SR 75

-100 million range where Table 4.11 showed slight jump from 10.8% for SR 50-75 million range to 14.2%.

Additionally, the participants indicated that they are practicing some of the project management activities as shown in Table 4. 12 and Figure 4.6. Among these are planning and scheduling (31.5%), cash budgeting (12.5%), cost control (18.75%), preparation of accounting reports (10.93%), quality control (31.5%), and production control (1.56%). From Table 4.12, it is evident that all participants are practicing planning and scheduling and quality control (inspection). The involvement in project supervision is one of the criteria set as a condition to participate in this study.

Table 4.8. Nature of clients served by A/E firms.

Clients	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Public	40		5	28	40		20	5	35	2	10	5	35	10		45	25	10	315	18.5
Saudi Aramco	30	100	60	8	30			50	25	40		40	25	40		35	10	50	543	30.2
SABIC	10		20	8				5	5	20		10	5	10			5	20	118	6.5
Royal Commission	5			4	20					13			5	10		15	5		82	4.5
SCECO			5	2				10		20			15			5	5	5	62	3.4
SWCC														15					15	0.008
Business	10		5	23	10	30	20	20	35	2	30	40	10	5	20	5	20	5	290	16.1
Residential	5			25		70	60	10		1	40	5	5	5	80		25		331	18.4
Self(own Spec. Dev.)			5	2						2	20			5			5	5	44	2.4
																	Grand Total percent		1800	100

- Numbers in columns 1 to 18 are percentages

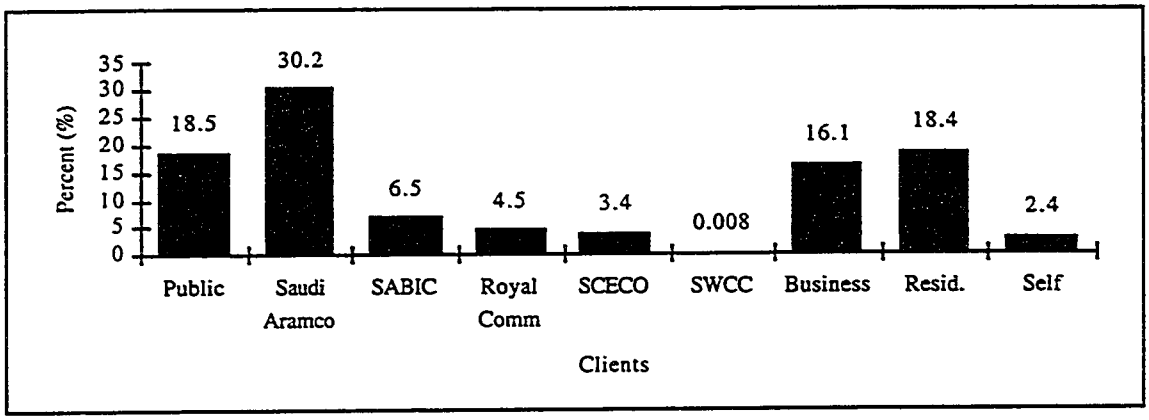


Figure 4.3. Client's share of engineering and consultancy services.

Table 4.9. Types of services rendered by participating A/E firms .

Category	Respondents																		Frequency	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Consultant	x		x	x							x	x	x				x	x	8	44.4
Architecture					x		x	x	x	x	x		x	x	x	x	x	x	12	66.7
Civil		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	16	88.9
Mechanical		x	x	x	x		x	x	x	x	x		x	x	x	x	x	x	15	83.3
Chemical			x		x								x			x		x	5	27.8
Electrical		x	x	x	x		x	x	x	x	x		x	x	x	x	x	x	15	83.3
Geological													x						1	5.6
Instrument			x															x	2	11.1
Surveying											x								1	5.6
Communication																	x		1	5.6

N = 18

Table 4.10. Types of projects A/E firms involved in.

Type of projects	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Buildings	30		20	30	35	20	80	45	30	3	10	70	25	20	20	30	25	15	538	29.9
Highways	20			10	10				20	2	5		15	10		10	5		107	5.9
Industrial	30		25		25		10	60	10	90	20	15	35	30		20		30	365	20.3
Site Development	20		5	10	5	20	10	5	15	2	15	15	10	10		10	15	5	172	9.5
Marine		100																	100	5.5
Pipelines			50															50	100	5.5
Medical & Utilities									25										25	1.4
Residential				50	25	60				3	50		10	30	80	30	55		393	22
																		Grand Total percent	1800	100

- Numbers in columns 1 to 18 are percentages

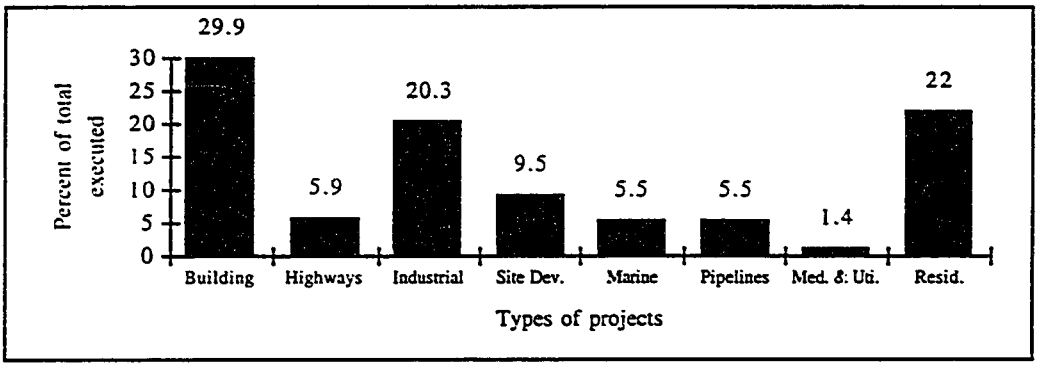


Figure 4.4. Percent of involvement in different types of projects.

Table 4.11. Sizes of designed and supervised projects.

Size of project (SR MM)	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Less than 5	50		10	5		100	20	90	10	20	40	50	25	20	70		20	5	535	29.8
5 to 25	40	10	10	15	5		30	10	15	40	20	25	30	15	30	10	30	15	360	20
25 to 50	10	30	20	15	10		20		25	35	15	25	10	40		20	15	15	305	16.9
50 to 75		30	20	20	15		10		25	5	10		10	5		20	15	20	195	10.8
75 to 100		20	30	25	40		10		15		15		10	10		30	15	35	255	14.2
more than 100		10	10	20	30		10		10				15	10		20	5	10	150	8.3
																			Grand Total percent	1800	100

- Numbers in columns 1 to 18 are percentages

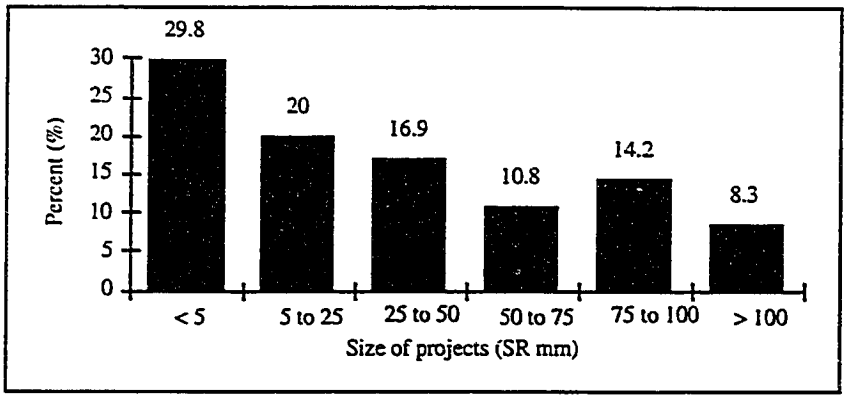


Figure 4.5. Percent of project sizes.

Table 4.12. Relative proportions of practiced project management activities.

Project Management activities	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Planning and scheduling	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	18	28.13
Cash budgeting		x	x				x		x	x			x	x				x	8	12.50
Cost control	x	x	x	x			x		x	x	x		x	x			x	x	12	18.75
Preparation of accounting reports	x	x							x	x		x	x	x					7	10.93
Quality control (Inspection)	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	18	31.5
Production control															x				1	1.56
																		Grand Total percent	64	100

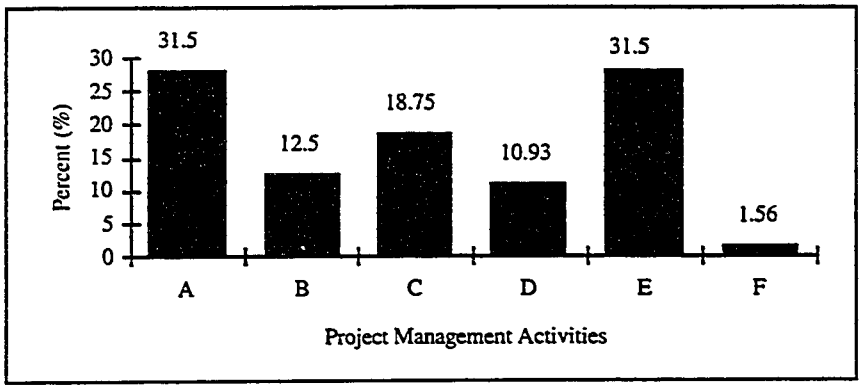


Figure 4.6. Project management activities practiced by project management activities.

Where,

A: Planning and scheduling.
B: Cash budgeting.
C: Cost control.
D: Preparation of accounting reports.
E: Quality control (inspection).
F: Production control

4.5 COST ESTIMATION SERVICES

The participating (A/E) firms indicated that 82.7% of cost estimation services rendered to clients were as part of the design package and 17.3% in the form of separate ones. Most of the (A/E) firms provided both forms of cost estimation but with type A dominated type B in terms of proportion. as shown in Table 4.13. and Figure 4.7. The reason behind providing cost estimation services as a support service to their operation.

The following paragraphs present description of the estimating unit and the types of estimates prepared by (A/E) firms.

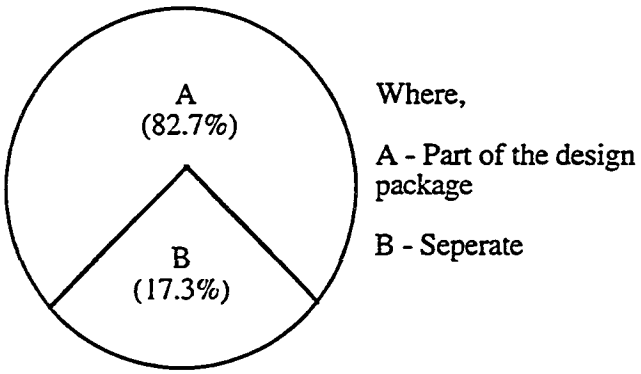


Figure 4.7. Proportions of provided cost estimation services.

Table 4.13. Forms of rendering cost estimation services.

Forms of cost estimation services (%)	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Part of the design (Package A)	100	100	100	90	100	60	100	100	70	20	100	50	100	50	60	100	90	100	1490	82.7
Separate (B)	0	0	0	10	0	40	0	0	30	80	0	50	0	50	40	0	10	0	310	17.3
																		Grand Total percent	1800	100

4.5.1 Cost Estimation Department

As shown in Table I-2 in appendix I, the majority of (A/E) firms (72.2%) indicated that they have cost estimating department while the remaining (A/E) firms (27.8%) stated that cost estimation practice is meshed with other engineering services. For the cost estimation practice being vital in current project development, 27.8% of nonexisting cost estimating departments is high.

The following paragraphs present a detailed description of cost estimating department in (A/E) firms in terms of their location in the organization structure, their given names, their number of years of experience the number of employees and their nationalities working as estimators, and the average number of years working as estimators. The information is compiled to provide an overview of some of the responses with reference to the cost estimating department. The above variables will be analyzed separately and the number of years of experience and the number of years of experience working as estimators, respectively will be compared.

4.5.1.1 Department Position in the Organization Structure

Participating (A/E) firms provided organization structures that included the position of their estimating departments. Sixteen out of eighteen respondents provided adequate representations. The remaining two indicted

that they do not have separate department for estimating purposes. This is contrary to the responses provided in Table I-2 in appendix I where four respondents indicated that they do not have separate estimating departments and one respondent did not provide a response. The only explanation to this discrepancy is that the information presented in Table I-2 in appendix I referred to the availability of estimating department working independently from other groups in neighboring structures while the response regarding the organization structure refers to the availability of estimating group but with no set boundaries from neighboring structures.

Fourteen (A/E) firms indicated that they position their estimating group in the organization structure directly beneath the engineering manager/director or project manager. Two firms stated that their estimating departments report directly to the executive management of the organization. The position of the estimating group under the engineering manager or project manager may provide positive outcome since it creates smooth development of engineering and cost estimating. On the other hand, this may cause manipulation of estimating group by engineering manager or project manager by hiding the lack of control on scope development behind deflated cost estimates.

4.5.1.2 Name of Cost Estimating Department

The cost estimating departments are called differently by responding (A/E) firms depending on the position of such department on their organization charts. The most frequent position is being under project

support/control which includes divisions such as materials, accounting, planning and scheduling. Table 4.14 shows the different names for estimating department.

Table 4.14. Name of cost estimating department.

Name of the estimating department	Frequency	Percent	Commulative frequency	Commulative percent
Material group	3	16.7	3	16.7
Project support/control	3	16.7	6	33.4
Quantity surveying	2	11.1	8	44.5
Estimating group	1	5.5	9	50
Material & quantities	1	5.5	10	55.5
Central coordination unit	1	5.5	11	61
Civil department	1	5.5	12	66.5
Engineering department	1	5.5	13	72
No department	4	22.5	17	94.5
No response	1	5.5	18	100

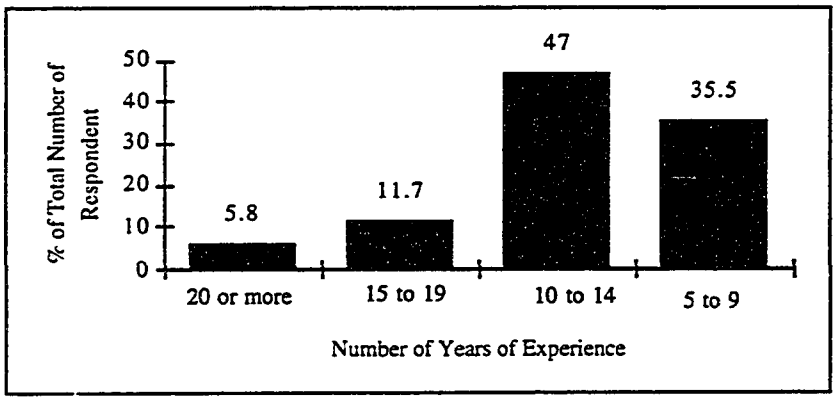
4.5.1.3 Department's Experience

The number of years of experience exhibited in Table 4.15 and Figure 4.8 seems to be adequate in general. Most estimators (47%) have from 10 to 14 years of experience. The others (35.5%) have less but,

nevertheless, satisfactory 5 to 9 years of experience. The 10 - 14 years of experience seems to be more common than others even of lesser number of years of experience. This result coincides with the idea that the parties associated with project development became cost conscious at the late seventies and early eighties due to the economic conditions.

Table 4.15. Estimator's average number of years of experience.

Number of years of experience	Frequency	Percent
20 or more	1	5.8
15 to 19	2	11.7
10 to 14	8	47
5 to 9	6	35.5



Fiqgures 4.8: Years of experience and the proportion of existence

4.4.1.4 Cost Estimating Staff

The number of employees working as estimators ranged widely from one to twelve employees. The results indicate that the most common department size is three employees. The other sizes larger than one and smaller than three employees did not exceed 11.1% of occurrence. Table 4.16 shows the number of employees and the frequency of occurrence.

Table 4.16. The number of employees working in the estimating department.

Number of employees working as estimators	Frequency	Percent	Commulative frequency	Commulative percent
12	2	11.1	2	11.1
9	2	11.1	4	22.2
5	2	11.1	6	33.3
4	2	11.1	8	44.4
3	6	33.3	14	77.7
2	2	11.1	16	88.8
1	1	5.5	17	94.5
No response	1	5.5	18	100

Table 4.17 shows the frequency of existence of nationalities in the estimating group of participating (A/E) firms. It is evident that Filipinos (23.4%), Indians (21.3%), Egyptians (14.8%), Pakistani (10.6%), and American (10.6%) are among the most common.

Table 4.17. The nationalities of estimators.

Nationality of estimators	Frequency	Percent	Commulative frequency	Commulative percent
Filipino	11	23.4	11	23.4
Indian	10	21.3	21	44.7
Egyptian	7	14.8	28	59.5
Pakistani	5	10.6	33	70.1
American	5	10.6	38	80.7
Lebanese	4	8.5	42	89.2
English	2	4.2	44	93.4
Canadian	1	2.1	44	93.4
Syrian	1	2.1	46	97.9
Palestinian	1	2.1	47	100
Saudi Arabian	0	0	47	100

N = 17

On the otherhand, the number of years of experience as estimators is shown in Table 4.18. It ranged from one year to 10 years. The results indicate that the most common experience period is three to four years (29.6%) then five to six years and seven to eight years of experience (23.5%). The distribution of years of experience shows the recent timing of realization of cost estimation importance to project development.

Table 4.18. Numbers of Years Working as Estimators.

Number of years working as estimators	Frequency	Percent
9 to 10	2	11.7
7 to 8	4	23.5
5 to 6	4	23.5
3 to 4	5	29.6
1 to 2	2	11.7

The average number of years of experience and the average number of years of experience as an estimator in Sections 4.5.1.3 and 4.5.1.4 were compared and listed by respondent in Table 4.19. The proportion between the years of experience ranged widely from 8.3 to 100. The proportion of 10 respondents exceeded 50%. This indicates that either the selection of estimators was not on the basis of their engineering experience but, rather, on their availability or that project managers do not consider engineering experience of major importance for cost estimators.

Table 4.19. Comparison between the number of years of experience and the number of years of experience as estimators for each respondent.

Respondent	Average number of years of exper.	Avg. number of years of exp. working in estimating group	Proportion (%)
1	12	1	8.3
2	10	2	20
3	8	3	37.5
4	12	8	66.7
5	18	6	30
6	8	3	37.5
7	10	10	100
8	10	5	50
9	10	9	90
10	23	4	17.4
11	14	8	57.1
12	N.R	N.R	—
13	12	7	58.3
14	8	7	87.5
15	8	4	50
16	18	6	30
17	8	6	75
18	8	4	50
	197 years	93 years	

The results, also, reveal that ten (A/E) firms have all of their cost estimators solely dedicated to work in cost estimating activities. The other eight participants indicate that their estimator are involved in other activities, possibly engineering or project control, in addition to their

involvement in cost estimation activities. It is evident that (A/E) firms who have dedicated cost estimators are those who have estimating departments. On the other hand, (A/E) firms who have non dedicated cost estimators are combination of (A/E) firms who have estimating department and (A/E) firms who do not have estimating departments.

Finally, (A/E) firms (50%) stated that their estimating groups have only one type of education while the remaining 50% indicated that their groups have variety of types of education as shown in Table 4.20. Only 12.20% of the total number of estimators have diplomas as one type of education while 59.7% of the total number of estimators have BS in engineering and 28.1% have BS in engineering plus some special training. On the other hand, none of the participating (A/E) firms stated that they have a complete crew of estimators with only diplomas as their ultimate educations while 33.3% and 22.2% indicated that they have complete crews with BS in engineering and BS in engineering plus some special training, respectively. See Table 4.21 and Figure 4.9. It is obvious that the cost estimators have proper type of training in terms of engineering requirement and they may lack the type of training that qualities them to be full aware of the cost estimating process.

Table 4.20. Estimators type of education.

Type of education of estimators	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Mostly Diplomas			100	60				50	25			25						60	220	12.2
Mostly BS in Engineering		100	40	100		100	90	50	50		50	75	100	80	100		100	40	1075	59.7
Mostly BS in Eng. with special training	100				100		10		25	100	50			20		100			505	28.1
N = 18																Grand Total percent			1800	100

- Numbers in columns 1 to 18 are percentages

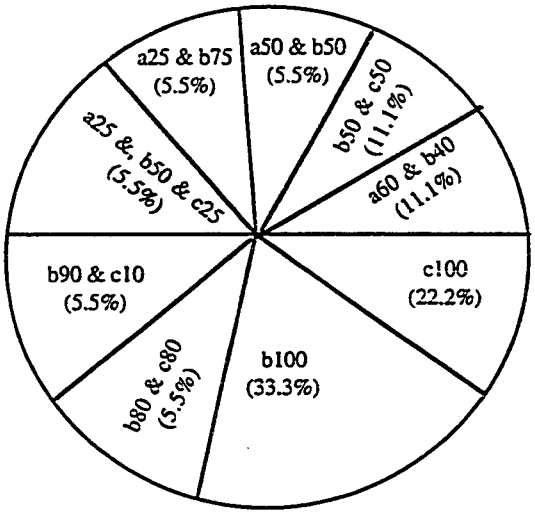


Figure 4.9. The proportions for different types of education.

where,

a: mostly diplomas.
b: mostly BS in engineering.
c: Mostly BS in engineering with special training.

Table 4.21. The frequency and proportion of estimator's type of education.

Type of education of estimators	Frequency	Percent
b100	6	33.3
c100	4	22.2
a60 & b40	2	11.1
b50 & c50	2	11.1
a50 & b50	1	5.5
a25 & b75	1	5.5
a25, b50 & c25	1	5.5
b90 & c10	1	5.5
b80 & c20	1	5.5

N=18

Where,
a: denotes mostly diplomas.
b: denotes mostly BS in engineering.
c: denotes mostly BS in engineering with special training.

4.5.2 Types of Estimates Prepared

Table 4.22 shows the different types of Cost Estimates developed by participating (A/E) firms. Eight (A/E) firms stated that they develop feasibility cost estimates, fifteen (A/E) firms develop Budget Cost Estimates, fourteen (A/E) firms develop Design Cost Estimates, and four (A/E) firms develop other types of cost estimates. It is evident that the practicing of Budget Cost Estimating (93.8%) and Design Cost Estimating (87.5%) are the most common where the practicing of feasibility cost estimating (50.0%) and other types of cost estimating (25.0%) are the least

common. The frequencies of practicing Budget Cost Estimation and Design Cost Estimation are expected results due to the importance of these cost estimation practices, especially Budget Cost Estimation, to clients. However, the frequency of practicing Feasibility Cost Estimation is considered low and was expected to be more commonly practiced.

Table 4.22. Different types of estimates tendered by participating A/E firms

S.No.	Types of Estimates Answered	Respondents																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total	%
a	Feasibility Estimates	X					X		X			X		X	X	X				8	50
b	Budget Estimates	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	15	93.8
C	Design Estimates	X	X	X	X	X	X	X	X					X	X	X	X	X	X	14	87.5
D	Other Types of Estimates	X	X				X							X						4	25

N=16

The participating (A/E) firms prepare various type of cost estimates for different types of projects.

The majority (67.7%) of estimates are prepared for new projects while estimates for renovation projects, change orders, and as built projects are performed in proportion of 14.7%, 14.3%, and 3.3% respectively as shown in Table 4.23 and Figure 4.10

Even when the (A/E) firms perform combination of cost estimates, the "estimates for new projects" were dominant in terms of quantity. There is only one (A/E) firm which prepares estimates for only new projects. None of the other three types of estimates, estimates for renovation projects, estimates for change orders, or estimates for as built project were developed by itself. The only reason where estimates for new projects were performed in such dominant quantity is because cost estimating practice in (A/E) firms is not considered a stand alone service but rather a support service for engineering services. This is evident when we remember that the majority of cost estimating departments work under the engineering division on the organization structure.

Table 4.23. Nature of cost estimates tendered by A/E firms.

Nature of estimates	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Estimates for new project	50	40	60	95	90	50	70	70	35	80	70	60	100	60	50	80	90	60	1220	67.7
Estimates for renovation proj.	25	30	20	4	5	5		20	30	10	20	20		30	10	10	5	20	264	14.7
Estimates for change orders	25	30	20	1	5	5	30	10	35	10	5	20		10	20	10	5	20	256	14.3
Estimates of as built projects					40									20					60	3.3
N = 18															Grand Total percent				1800	100

Numbers are percentages

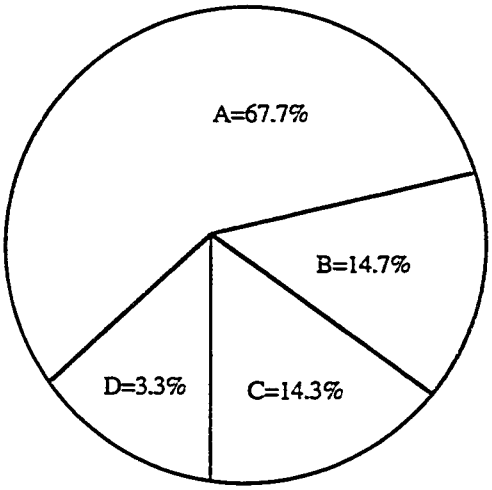


Figure 4.10. The proportions of different types of estimates provided by respondents.

A= Estimates for new projects.
B= Estimates for renovation projects
C= Estimates for change orders.
D= Estimates of as built projects.

The participating (A/E) firms indicated that they provide different types of cost estimates. The results from Table 4.24 and Figure 4.11, indicate that almost all types of cost estimates are provided by some of the responding (A/E) firms including feasibility estimates (10%), conceptual estimates (10%), budget estimates (27.5%), control estimates (8.6%), bid evaluation estimates or design estimates (26.9%), progress estimates (11.9%), value engineering analysis estimates (2.8%), life cycle costing analysis estimates (1.7%), and project cost analysis estimates (0.005%).

The responses show that budget estimates are performed more frequently than others which support results shown in section 4.5.2 and that bid evaluation estimates (design estimates) is practiced by all responding

(A/E) firms. Again, the cost estimates that are not considered part of the engineering development such as progress estimates and project cost analysis estimates are not practiced often due to their simplicity and being handled by clients. In addition, the cost estimates for some of the engineering practices that are not commonly practiced such as value engineering analysis and life cycle costing analysis are also not practiced often due to their being fairly new activities in local (A/E) firms.

Table 4.24. Types of cost estimates performed by A/E consultants.

Type of estimates	Respondents																		Total	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Feasibility estimates	30	5				50			15	5	15			20	40				180	10
Conceptual estimates	5	10		5	5	5	10		10	20			80	10	10	10			180	10
Budget estimates	20	40	50	50	10	5	10	50	15	20	55	40		20	10	10	40	50	495	27.5
Control estimates	20	30		30			10		10	20	5			10			20		155	8.6
Bid evaluation estimates	10	15	40	15	65	10	20	50	15	5	10	50	20	20	10	50	40	40	485	26.9
Progress estimates	10		10		5	30	50		10	20	10	10		10	30	10		10	215	11.9
Values eng. analysis est.	5				10				15	5	5			10					50	2.8
LCC analysis estimates					5				10	5				10					30	1.7
Project cost analysis est.												10							10	0.005
N = 18															Grand Total percent				1800	100

- Numbers in columns 1 to 18 are percentages

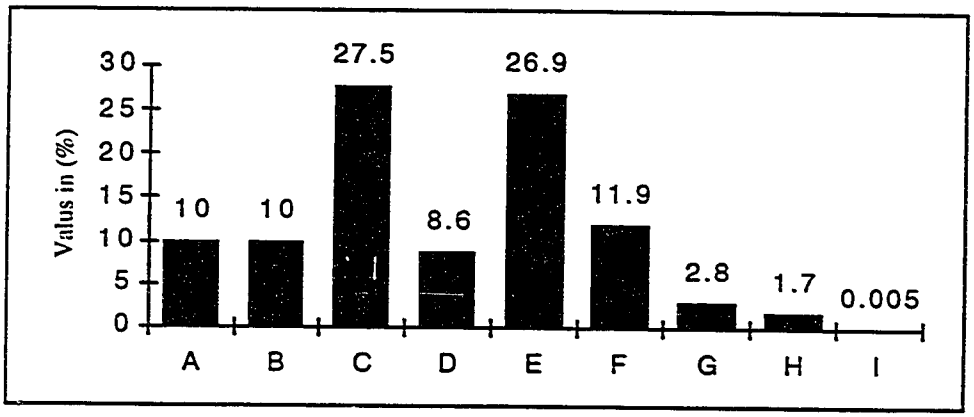


Figure 4.11. The proportion of performed cost estimates.

Where,

A: Feasibility estimates
B: Conceptual estimates
C: Budget estimates
D: Control estimates
E: Bid evaluation estimates
F: Progress estimates
G: Value Eng. analysis est.
H: LCC analysis estimates
I: Project cost analysis est.

4.5.2.1 Feasibility Cost Estimates

Only eight (A/E) firms stated that they provide feasibility cost estimates to clients as shown in Table 4.22 and 4.25. However, only five out of the eight (A/E) firms provided outline to their feasibility cost estimating procedures and their characteristics.

4.5.2.1.1 Procedures and Characteristics

Table 4.25 shows the procedures, the variations to the procedures, and the characteristics of feasibility cost estimates as viewed by participating (A/E) firms.

Generally, the respondents use the following procedures to develop Feasibility Cost Estimates.

1. Define the scope of the project in terms of standard building and miscellaneous items that support that building such as parking areas, fencing, etc. Define extra requirements which are indicated by the client or regulatory organizations.

2. Evaluate the specialties of the projects site such as access, type of terrane, distance from the city or production plants such as batching plants, steel factory, etc.

3. Use rate/unit size of construction from records of previous projects for standard type of facility and then add allowances for special requirement.

4. Obtain prices for required major equipment from suppliers.

5. Forecast the timing of project development and apply appropriate price indices.

6. Adjust the cost to allow for company overhead and contingency.

Table 4.25. The Procedures and Characteristic of Feasibility Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Feasibility Estimate	1	- Define scope of work - Investigate - Site, owner's requirements materials supplier, historical data correction of similar projects. - Apply price index - Develop cost estimation - Apply contingency	No	- Quick - Comparatively easier. - Fairly accurate - Simple	- Not available for high contract values (Projects with special requirements)
	2	- Done based on factored costs for similar projects since very little design available and only approximate capacities, quantities, or condition known.	No	- Rapid development of order of magnitude costs.	- Only limited to similar scope types where historical cost data is available.
	6	- Provide estimate 5-10% within the true estimate. (No explanation of the method)	Sometimes	- Follows market trend.	- Does not reflect the effect of quality or type of supervision.
	9	- No response	Generally	- Hands on - Project specific - Customized to - standard projects	- Labor intensive - costly - Not automated

Table 4.25. The Procedures and Characteristic of Feasibility Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Feasibility Estimate	11	- No response	No	No response	No response
	13	- Based on supplier's prices on major equipment and our records from similar projects for construction and materials costs. (± 30% of true cost)	No	- Simple - Quick to use - Somewhat accurate - Comparatively easier	- Inconsistent from one project to another.
	14	- No response	No	No response	- No response
	15	- Use rate/unit size of construction available with us to find the cost of standard facility.	No	- Follows market trend	- Not automated - Time consuming - Hard to check and update

All the participating (A/E) firms indicated that they use these procedures at all times with no variations.

The respondents provided some strengths and weaknesses for their methods although some of them provided no responses about the procedures. Some of the main strengths are as follows:

1. The use of the procedures listed earlier makes it quick to develop the estimate.
2. Procedure is brief and systematic which makes it easy to use.
3. Fairly accurate considering the brief nature of the procedure.
4. Simple due to the inexistance of hard computations.
5. Follows market trends by using current material prices and price indices.
6. Hands on due to its practicality.
7. Project specific by relying specific scope.
8. Customized to standard projects since it uses cost unit rate of construction of standard building.
9. Consistent in providing results from one project to another.

Some of the main weaknesses for the tabulated procedures are as follows:

1. Not available for higher contract values (Projects with special requirements)
2. Only limited to similar scope projects where historical data is available.
3. Do not reflect the level of quality or type of supervisions.
4. Not automated
5. Hard to check and update.

4.5.2.1.2 Input Information

The participating (A/E) firms indicated their perception of how important this information for the preparation of feasibility cost estimates. The list included thirteen items and the respondents were given the choice to provide others that may be of importance.

Table 4.26 shows the view of participating (A/E) firms regarding the importance of items required for preparing feasibility cost estimates. In general, the respondents tended to consider all the items of some importance. They even provided some from their own such as availability of contractors, workers' nationalities, types of supervision, and period of construction. The respondents considered these items of major importance.

Table 4.27 show the mean response of each piece of information, the standard deviation and the ranking. With the level of importance ranging from 1 to 5 with 1 being extremely important and 5 extremely unimportant, the mean responses ranged from 0.2 which is very close to extremely important to 3.11 which is slightly into the negative response toward major unimportance. The majority of the information items were located between 2 and 3 which is between major importance and important. Table 4.27 shows the ranking of the overall selection of importance that these piece of information have.

Table 4.26. Level of importance of information required for preparing feasibility cost estimates

S.N.	Type of information important for preparing feasibility cost estimates	Responses					
		Extreme importance	Major importance	Important	Major un-importance	Extreme un-importance	Mean*
1.	Functional program of the facility	2 2.5	3 37.5	2 25	0 0	1 12.5	2.375
2.	Architectural program of the facility	0 0	3 33.3	5 55.6	0 0	1 11.1	2.889
3.	Location of the project	1 11.1	3 33.3	3 33.3	2 22.3	0 0	2.668
4.	Time of construction starting	3 37.5	1 12.5	2 25	2 25	0 0	2.375
5.	Owner's requirements	6 75	1 12.5	1 12.5	0 0	0 0	1.375
6.	Regulation requirements	3 37.5	2 25	0	2 25	1 12.5	2.500
7.	Zoning	1 11.1	3 33.3	2 22.3	0 0	3 33.3	3.111
8.	Weather	0 0	3 37.5	3 37.5	2 25	0 0	2.875
9.	Site conditions	2 22.3	4 44.4	3 33.3	0 0	0 0	2.110
10.	Complexity of the project	2 22.3	5 55.5	2 22.2	0 0	0 0	1.999
11.	Economic conditions	1 12.5	3 37.5	4 50	0 0	0 0	2.375
12.	Construction methods	2 25	4 50	2 25	0 0	0 0	2.000
13.	Technology requirements	2 28.6	3 42.8	1 14.3	1 14.3	0 0	2.143
14.	Availability of contractors	0 0	1 100	0 0	0 0	0 0	0.200
15.	Workers nationalities	0 0	1 50	1 50	0 0	0 0	2.500
16.	Type of supervision	0 0	2 100	0 0	0 0	0 0	0.200
17.	Period of construction	0 0	2 100	0 0	0 0	0 0	0.200

* Ranges from 1 (extreme importance) to 5 (extreme unimportance).

Table 4.27. Level of importance of information required for preparing feasibility cost estimates.

S.No.	Type of information important for preparing feasibility cost estimates	Mean* responses	Standard deviation	Rank
1	Functional program of the facility	2.375	1.55	7
2	Architectural program of the facility	2.889	2.23	10
3	Location of the project	2.668	1.79	9
4	Time of construction starting	2.375	0.80	7
5	Owner's requirements	1.375	2.33	2
6	Regulation requirement	2.500	1.32	8
7	Zoning	3.111	1.96	11
8	Weather	2.875	2.125	9
9	Site conditions	2.110	1.82	5
10	Complexity of the project	1.999	2.06	3
11	Economic conditions	2.375	2.38	7
12	Construction methods	2.000	1.73	4
13	Technology requirements	2.143	1.34	6
14	Availability of contractors	0.200	0.45	1
15	Worker's nationalities	2.500	2.30	8
16	Type of supervision	0.200	0.92	1
17	Period of construction	0.200	0.92	1

*Ranges from 1 (extreme importance) to 5 (extreme unimportance).

In order to make the level of importance of all types of information required for preparation of feasibility cost estimates more visible, the positive responses (extreme importance and major importance) and the negative responses (extreme unimportance and major unimportance) were segregated from neutral responses. Table 4.28 and Figures 4.12 and 4.13 show the proportions of extreme and neutral responses after the

segregation is performed. Figure 4.12 shows general shift of(A/E) responses toward the positive side with an average positive response of 65.47% and average negative response of 10.64%. The average neutral response is 23.89% which indicates that our respondents departed from being neutral and chose the extreme responses for their opinion of how important the list of information required for preparing feasibility cost estimates.

Table 4.28. Proportions of extreme and neutral responses (%) of information required for preparing feasibility cost estimates.

S.No.	Types of information important for preparing feasibility cost estimates	% of extreme responses		% of neutral responses
		positive	negative	
1.	Functional program of the facility	62.5	12.5	25
2.	Architectural program of the facility	33.3	11.1	55.6
3.	Location of the project	44.4	22.3	33.3
4.	Time of construction starting	50	25	25
5.	Owner's requirements	87.5	0	12.5
6.	Regulation requirements	62.5	37.5	0
7.	Zoning	44.4	33.3	22.3
8.	Weather	37.5	25	37.5
9.	Site conditions	66.7	0	33.3
10.	Complexity of the project	77.8	0	33.3
11.	Economic conditions	50	0	22.3
12.	Construction methods	75	0	25
13.	Technology requirements	71.4	14.3	14.3
14.	Availability of contractors	100	0	0
15.	Workers nationalities	50	0	50
16.	Type of supervision	100	0	0
17.	Period of construction	100	0	0

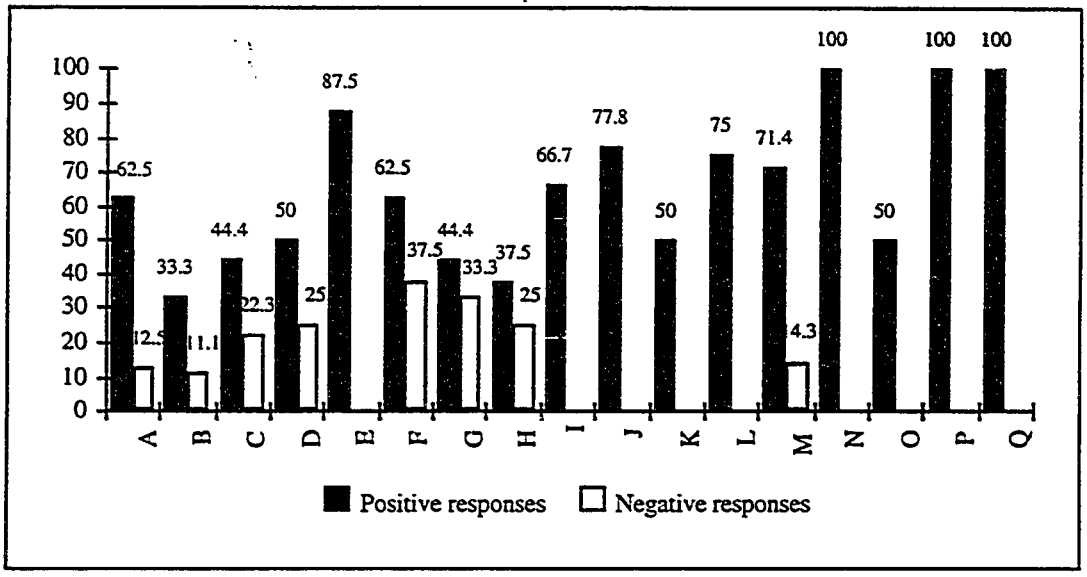


Figure 4.12. Extreme responses for the level of importance of information used for preparing feasibility cost estimates.

Where,

A: Functional program of the facility
B: Architectural program of the facility
C: Location of the project
D: Time of construction starting
E: Owner's requirements
F: Regulation requirements
G: Zoning
H: Weather
I: Site conditions
J: Complexity of the project
K: Economic conditions
L: Construction methods
M: Technology requirements
N: Availability of contractors
O: Workers nationalities
P: Type of supervision
Q: Period of construction

Figure 4.12 shows that the respondents considered the "Architectural program of the facility", "location of the project", "weather", "site conditions" and "economic conditions" to be of importance. The consideration of the "Architectural program of the facility" to be of importance is due to its role in defining the scope of the project. In addition, the consideration of the "location of the project" to be of importance is reasonable since it plays an important role in considering the feasibility of the project and due to its significant contribution to the cost of the project. The consideration of the weather as an important type of information is surprising. One will think that will not have that magnitude of importance. The severe weather that the Kingdom experiences and its role on the productivity of labor for example may be the reason behind the importance of being aware of it. Finally, information about "site the conditions" and "economic conditions" were considered of importance due to their significant impact on the cost of the project which is a reasonable result. Information regarding the "Owner's requirements", "Regulation requirements", Complexity of project", and "Type of supervision" were expected to have more importance that the result show.

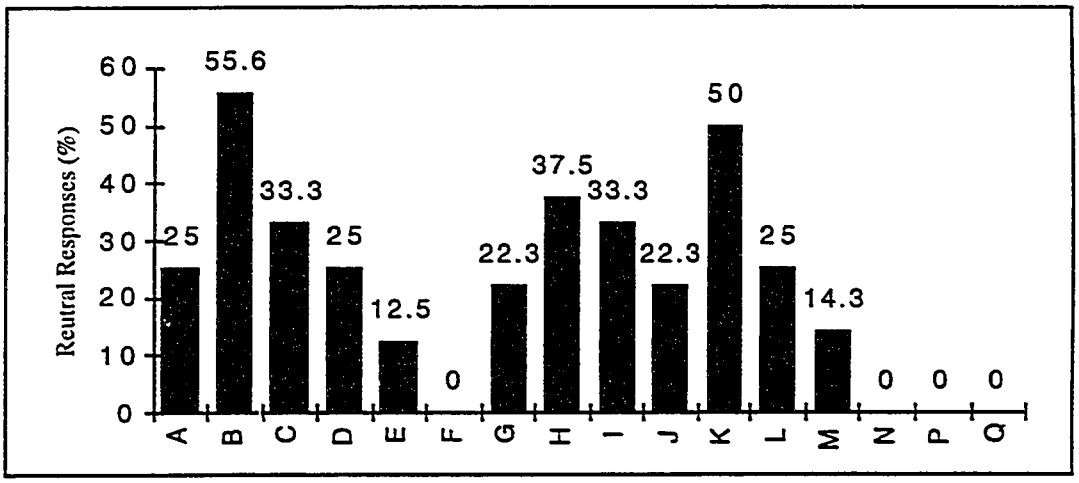


Figure 4.13. Neutral attitude towards the level of importance of types of information used for preparing feasibility cost estimates.

Where,

A: Functional program of the facility
B: Architectural program of the facility
C: Location of the project
D: Time of construction starting
E: Owner's requirements
F: Regulation requirements
G: Zoning
H: Weather
I: Site conditions
J: Complexity of the project
K: Economic conditions
L: Construction methods
M: Technology requirements
N: Availability of contractors
O: Workers nationalities
P: Type of supervision
Q: Period of construction

4.5.2.1.3 Cost Information

The participating (A/E) firms provided cost information that are required for the development of feasibility cost estimates. The cost information were labor cost, material cost, machines cost, management cost, escalation cost, interest rate, cost index, price index, and unit cost per area of construction. In addition, the respondents provided additional cost items that they considered required for the development of feasibility cost estimates. The participants provided their responses as shown in Table 4.29 and Figure 4.14 for feasibility cost estimates. All cost information were selected by some respondents. Items such as labor cost, material cost, machine cost, management cost, escalation cost, and unit cost per area of construction were selected by five respondents out of the total number of respondents of eight respondents. Some participants indicated that cost information such as "historical cost data" and "percent of profit" are also required. The suggestion of these two cost information are not that clear since "historical cost data" is a combination of some items that were provided and "percent of profit" is an item that is reflected on the design estimate.

Cost information such as material cost, management cost, escalation cost, interest rate, price index, and unit cost per area of construction are important should a sound feasibility cost estimate be developed. They are required for the procedure of developing feasibility estimate shown in section 4.5.2.1.1. Cost information such as labor cost and machine cost are

normally not required for the development of feasibility cost estimates. They are embedded in other cost information such as unit cost per area of construction.

Table 4.29. Cost information used for preparing feasibility cost estimates.

#	Cost information used for preparing feasibility cost estimate	Respondent								Frequency	Percent
		1	2	6	9	11	13	14	15		
a	Labor cost	x		x	x	x	x	x	x	7	87.5
b	Material cost	x		x	x	x	x	x	x	7	87.5
c	Machine cost			x	x	x	x	x	x	6	75
d	Management cost	x		x			x	x	x	5	62.5
e	Escalation cost	x			x	x	x	x		5	62.5
f	Interest rate				x	x		x		3	37.5
g	Cost index	x			x	x		x		4	50
h	Price index	x				x		x		3	37.5
i	Unit cost per area of construction	x		x	x	x		x		5	62.5
j	Historical cost data		x							1	12.5
k	% of profit			x						1	12.5

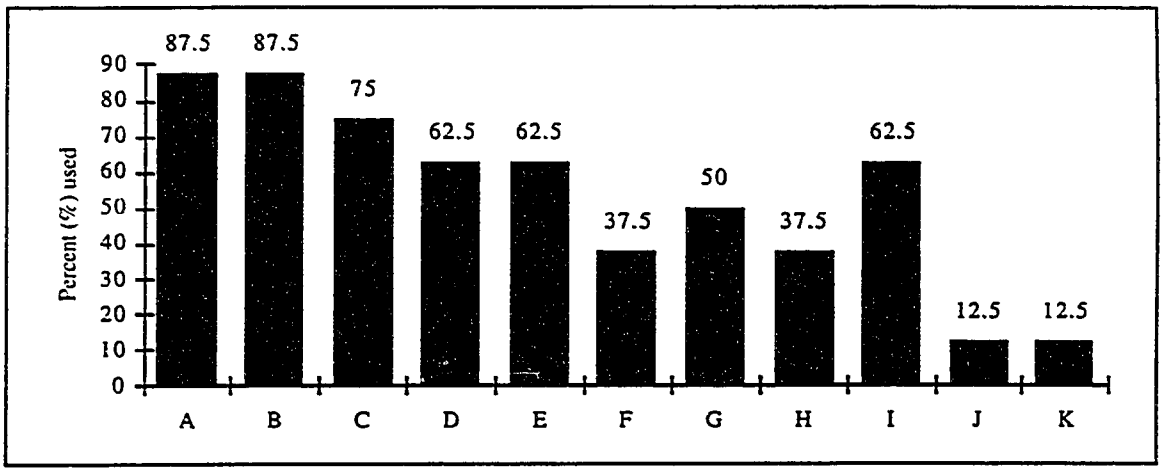


Figure 4.14. Cost information used for preparing feasibility cost estimates.

Where

A: Labor cost
B: Material cost
C: Machine cost
D: Management cost
E: Escalation cost
F: Interest rate
G: Cost index
H: Price index
I: Unit cost per area of construction
J: Historical cost data
K: % of profit

4.5.2.1.4 Sources of Cost Information

The participating (A/E) firms indicated the sources of their cost information required for the development of feasibility cost estimates. The participants provided two alternatives of sources of cost information such as 1) own historical records and 2) standard manuals. Some of the participants provided other items that they considered as sources of cost information.

For the sources of cost information of the feasibility cost estimates, all the responses and the proportions of usage of these sources and others that were provided by the respondents are shown in Table 4.30. All sources were selected by some participants. Some of the respondents suggested other means of gathering cost information such as material/equipment suppliers, Saudi Aramco, construction contractors, and market trends. All the suggested sources are considered legitimate sources of cost information.

Table 4.30. Sources of cost information used for preparing feasibility cost estimates.

S.No	Source of cost information	Respondents								Frequency	Percent
		1	2	6	9	11	13	14	15		
a	Own historical records	x	x	x	x	x	x	x	x	8	44.4
b	Standard manuals	x			x	x	x	x		5	27.8
c	Material/equipment suppliers	x								1	5.5
d	Saudi Aramco		x							1	5.5
e	Construction contractors			x					x	2	11.1
f	Market trends					x				1	5.5
									Total	18	100

Table 4.30 shows that "own historical records" and "standard Manuals" are the most common sources of cost information. They match other sources in terms of reliability but they are more comprehensive.

4.5.2.1.5 *Updating Cost Information*

The participating (A/E) firms provided some cost information and stated their responses on whether these cost information are updated during the development of feasibility cost estimates and, if so, how often. The cost information are contingency, cost trending, and construction prorates. The respondents, also, provided other cost information that they thought they ought to be included and updated.

At least five out of eight respondents indicated that all cost information are ought to be updated for feasibility cost estimates as shown in Table 4.31. One respondent suggested that project complexity is required to be updated during the development of feasibility cost estimate. This idea is unusual since the project complexity is a fixed criteria and its required to be identified only. Table 4.32 shows the frequency of updating cost information for the preparation of feasibility cost estimate. The three cost information were equally considered in terms of being adjusted or not. Five respondents indicated that they provide adjustments to these cost information while three indicated that they do not. The frequency of adjustments varied from one participants to another and no frequency is determined to be selected more often except for the frequency of adjusting construction prorates and, in this piece of information, three out of five

respondents indicated that the adjustments are done annually. The difference in the frequencies of adjustments to cost information is expected since the participants have different commitments to the integrity and accuracy of feasibility cost estimates. In addition, there are no set adjustments frequencies to these cost information in the technical or practical arena although annual adjustments are the most common.

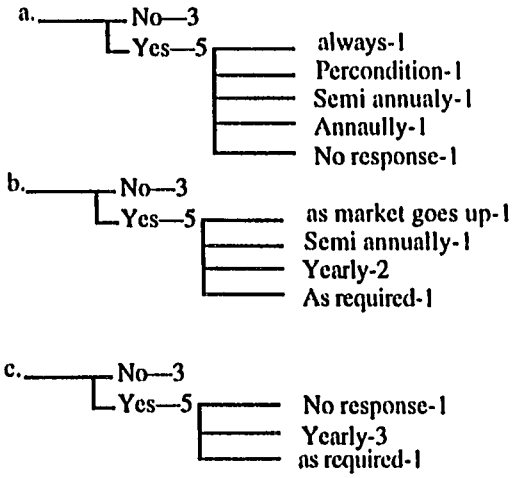
Table 4.31. Cost information to be adjusted when preparing feasibility cost estimate.

S.No.	Cost information to be adjusted for feasibility estimates	Respondents								Frequency	Percent
		1	2	6	9	11	13	14	15		
a	Contingency	x	x	x	x	x	x	x	x	8	100
b	Cost trending		x	x		x	x	x	x	6	75
c	Construction prorates	x		x		x		x	x	5	62.5
d	Project complexity		x							1	12.5

N=8

Table 4.32. Frequency of updating cost information for feasibility estimates.

S.No.	Cost information used for feasibility cost estimate	Respondents								Updated	Not Updated
		1	2	6	9	11	13	14	15		
a	Contingency	Yes	Yes (always)	Yes (percon dition)	No	Yes (semi annually)	No	Yes (yearly)	No	5	3
b	Cost trending	No	No	Yes (as market goes up)	No	Yes (semi annually)	Yes (yearly)	Yes (yearly)	Yes as) required)	5	3
c	Construction prorates	Yes	No	Yes (yearly)	No	Yes (annually)	No	Yes (yearly)	Yes (as required)	5	3



4.5.2.16 Use of Computers

Four (A/E) firms stated that they use computers in developing feasibility cost estimates. In addition, most of the participants provided names of the computer systems used as indicated in Table 4.33. Two of those four (A/E) firms use spread sheets, one uses estimate write and one declined to name the computer system used. The remaining three (A/E) firms indicated that they do not use computers in developing Feasibility Cost Estimates which is surprising. The reason behind the high percentage of (A/E) firms not using computers could be due to the simplicity of the development of Feasibility Cost Estimate compared to other types of estimates which makes manual development justified.

Table 4.33. The use of computers for the development of design cost estimates.

Type of estimate	Respondents updating and frequency of updating																Yes	No	Total
	1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18			
Feasibility estimates	Yes Excel	Yes (NR)				No			Yes (SS)		No	Yes (estimate writer)	No				4	3	7

A: Use of computer for feasibility estimates

No—3
Yes—4 Spread sheet (SS)-2
No response (NR)-1
Estimate write-1

4.5.2.1.7 Level of Satisfaction with the Characteristics of Cost Estimating Systems

The participating (A/E) firms provided a list of characteristics of cost estimating system for feasibility cost estimates. The respondents then, stated their level of satisfaction with these characteristics. In addition, the participants were given the choice to provided other characteristics that they might be satisfied with.

Table 4.34 shows all the responses regarding the level of satisfaction with the characteristics of cost estimating systems for feasibility cost estimates. In general, the respondents were somewhat satisfied with these characteristics. Some of the respondents provided "fits unprecies contracts" as an additional characteristics that they seemed to be satisfied with.

Table 4.35 and Table 4.36 show the level of satisfaction with the characteristics of estimating system the means responses, the standard deviation, and the ranking. With the level of satisfaction ranging form 1 (extreme satisfaction) to 5 (extreme dissatisfaction), the mean responses ranked form 1.8 which is close to major satisfaction to 3.14 which is slightly into the negative response toward major dissatisfaction. The majority of the characteristics means are located between 2 (major satisfaction) and 3 (fair satisfaction).

Table 4.34. Responses on level of satisfaction with the characteristics of estimating system used for feasibility cost estimates.

		No. of respondent who selected				
#	Characteristics of estimate system used for Feasibility Estimates	Extreme satisfaction	Major satisfaction	Fair satisfaction	Major dis-satisfaction	Extreme dis-atisfaction
1.	Reliable	1	5	2	0	0
2.	Easy to use	3	2	2	0	1
3.	Easy to update	1	3	2	1	1
4.	Easy to understand	3	1	4	0	0
5.	Compatible with MIS in your firm	1	1	4	2	0
6.	Provide accurate results	2	3	4	0	0
7.	Compatible with the technological capabilities that your firms has	1	0	6	1	0
8.	Easy to adjust to meet changes in parameters	1	5	2	0	0
9.	Comprehensive to all different types of const. projects	1	0	4	1	1
10.	Fits unprecise contracts	0	0	1	0	0

Table 4.35. Level of satisfaction with the characteristics of estimating systems used for feasibility cost estimates.

		Responses					
S.N.	Characteristics of Estimating Systems Used for Feasibility Estimates	Extreme satisfaction	Major satisfaction	Fair satisfaction	Major dis-satisfaction	Extreme dis-satisfaction	Mean*
1.	Reliable	1 12.5	5 62.5	2 25	0 0	0 0	2.13
2.	Easy to use	3 37.5	2 25	2 25	0 0	1 12.5	2.25
3.	Easy to update	1 12.5	3 37.5	2 25	1 12.5	1 12.5	2.75
4.	Easy to Understand the output	3 37.5	1 12.5	4 50	0 0	0 0	2.13
5.	Compatible with MIS in your firm	1 12.5	1 12.5	4 50	2 25	0 0	1.88
6.	Provide accurate results	2 22.2	3 33.3	4 44.5	0 0	0 0	2.22
7.	Compatible with the technical capabilities that your firms has	1 12.5	0 0	6 75	1 12.5	0 0	2.88
8.	Easy to adjust to meet changes in parameters	1 12.5	62.5	2 25	0 0	0 0	2.13
9.	Comprehensive to all different types of construction projects	1 14.3	0 0	4 57.1	1 14.3	1 14.3	3.143
10.	Fits with unprecise contracts (scope of work)	0 0	0 0	1 100	0 0	0 0	2.00

* Ranges from 1 (extreme satisfaction) to 5 (extreme Dissatisfaction).

Table 4.36. Level of satisfaction with the characteristics of estimating systems used for feasibility cost estimates.

#	Characteristics of estimating systems used for feasibility estimates	Mean*	Standard Deviation	Rank
1.	Reliable	2.13	2.16	6
2.	Easy to use	2.25	1.35	4
3.	Easy to update	2.75	1.35	3
4.	Easy to understand the output	2.13	1.91	6
5.	Compatible with MIS in your firm	1.88	1.55	2
6.	Provide accurate results	2.22	1.88	5
7.	Compatible with the technical capabilities that your firm has	2.88	2.89	2
8.	Easy to adjust to meet changes in parameters	2.13	2.16	6
9.	Comprehensive to all types of construction projects.	3.14	2.47	1
10.	Fits with unpricise contracts	2.00	2.06	7

* Ranges from 1 (Extreme Satisfaction) to 5 (Extreme Dissatisfaction)

Table 4.36 shows the ranking of the overall selection of satisfaction that these characteristics have.

In order to make the level of satisfaction with the characteristics of cost estimating systems more visible, the positive responses (extreme satisfaction and major satisfaction) and negative responses (extreme dissatisfaction and major dissatisfaction) were segregated from neutral responses. Table 4.37 and Figures 4.15 and 4.16 show the proportions of extreme and neutral responses after the segregation is made. Figure 4.15 shows general shift of (A/E) responses toward the positive side with an average positive response of 41.98% and an average negative reason of 10.36%. The average neutral response is 47.66% which indicates that the respondents chose to maintain neutral attitude when selecting the level of satisfaction with the characteristics of estimation systems for feasibility cost estimates.

Table 4.37. Proportions of extreme and neutral responses of characteristics of estimating systems used for feasibility cost estimates.

S.No.	Characteristics of estimating systems used for feasibility estimates	% of extreme responses		% of neutral responses
		Positive	Negative	
1.	Reliable	75	0	25
2.	Easy to use	62.5	12.5	25
3.	Easy to update	50	25	25
4.	Easy to understand the output	50	0	50
5.	Compatible with management information systems in your firm	25	25	50
6.	Provide accurate results	55.5	0	44.5
7.	Compatible with the technical capabilities that your firm has	12.5	12.5	75
8.	Easy to adjust to meet changes in parameters	75	0	25
9.	Comprehensive to all different types of construction projects	14.3	28.6	57.1
10.	Fits with unprecise contracts (scope of work)	0	0	100

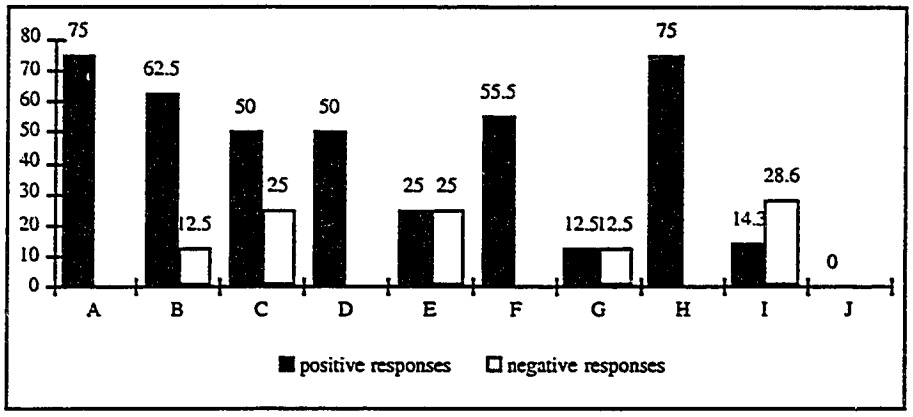


Figure 4.15. Extreme responses for the level of satisfaction with the characteristics of estimating systems used for feasibility cost estimates.

where,

A: Reliable
B: Easy to use
C: Easy to update
D: Easy to understand and the output
E: Compatible with MIS in your firm
F: Provide accurate results
G: Compatible with the technical capability that your firm has
H: Easy to adjust to meet changes in parameters
I: Comprehensive to all different type of construction projects.
J: Fits with unprecise contracts (scope of work)

All the characteristics of feasibility cost estimates that the participants stated their satisfaction with including reliability, easy to use, easy to update, easy to understand the output, and providing accurate results are consistent with the participants' previous indications on the strength of feasibility cost estimates discussed in section 4.5.2.1.1. However, the

characteristics "Easy to adjust to meet changes in parameters" which the participants indicated their satisfaction with was not considered earlier as a strength of feasibility cost estimates.

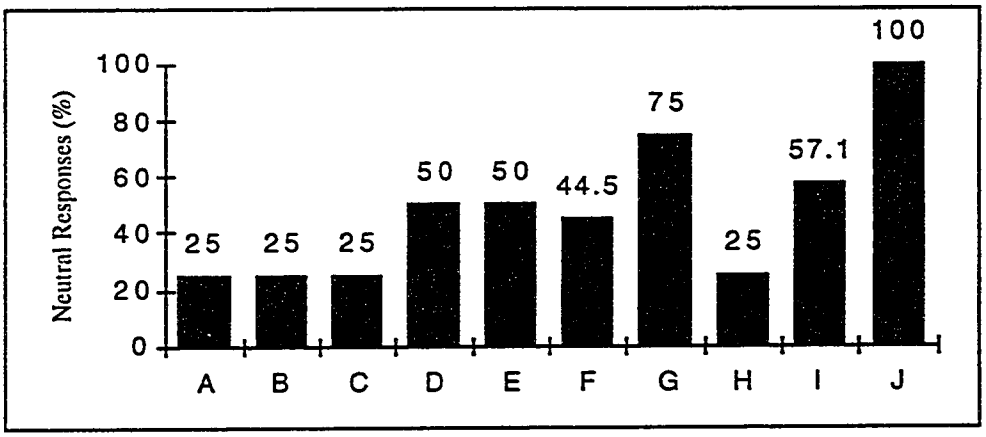


Figure 4.16. Neutral of attitude towards the level of satisfaction with the characteristics of estimating systems used for feasibility cost estimates.

where,

A: Reliable
B: Easy to use
C: Easy to update
D: Easy to understand and the output
E: Compatible with MIS in your firm
F: Provide accurate results
G: Compatible with the technical capability of that your firm has
H: Easy to adjust to meet changes in parameters
I: Comprehensive to all different type of construction projects.
J: Fits with unprecise contracts (scope of work)

4.5.2.1.8 Reliability of the Feasibility Cost Estimating System

The participating (A/E) firms provided feasibility cost estimates of projects that were designed and supervised during the last five years. In addition, the participants provided the corresponding bid prices for these projects. The purpose behind exhibiting these estimates and bid prices is to determine the variances between values of different cost estimates and bid prices which, in turn, will provide good and measurable scale of how good are these cost estimates compared with the bid prices, the true costs. Some of the participants, however, declined to provide this information claiming that it is restricted and clients do not allow the disclosure of such information. As a solution it was recommended to participants to provide an average variance between the cost estimate values and the bid prices. After further reluctance, the participants provided these variances. It is needless to say that the responses are considered the most vital information since it provides true and precise measure of evaluating the quality of developed design cost estimates. There were cases where participating(A/E) firms provided bid prices of performed projects prior to the evaluation and determination of the contract values. In these cases, it was assumed that the bid price is the lowest of these bidding values.

Technically, it has been determined that feasibility cost estimates are 30-40 % of the bid prices (Adrian, 1982).

Table 4.38 shows that the overall average of the average variances between feasibility cost estimates and bid prices to be 16.80% as opposed to expected ±30 - 40%. This result is very good and encouraging results.

Table 4.38. The overall average of the average variances between feasibility cost estimate and bid prices.

Respondents	Average variance between feasibility estimates and bid prices (±%)
1.	14.7
2.	15
6	17
9	20
11	18.8
13	20
14	14
15	15
	average ± 16.8%

4.5.2.2 Budget Cost Estimates

Table 4.22 shows the proportion of participating (A/E) firms who develop Budget Cost Estimate as part of their engineering services. The results show that Budget Cost Estimating is practiced by 93.8% of the participating (A/E) firms. It is considered the most commonly practiced compared to other types of cost estimations. The popularity of Budget Estimates comes as a result of the clients demands for this type of estimate.

4.5.2.2.1 Procedures and Characteristics

Table 4.39 shows the procedures, the variations to the procedures, and the characteristics of Budget Cost Estimates as viewed by participating (A/E) firms. There are sixteen out of eighteen participating (A/E) firms, who indicated that they provide Budget Cost Estimates. However, only (A/E) firms provided outline of their procedures and alongwith their characteristics. Similar to the description of Feasibility Cost Estimates Procedures, Budget Cost Estimates Procedures are also brief. In general, the respondents use the following procedures in order to develop Budget Cost Estimates:

1. List and group activities from tender documents
2. Determine materials/equipment take off quantities.
3. Obtain prices for item 1 from materials suppliers.
4. Use rate/unit size of construction form records of previous projects.

5. Reflect allowances for special requirements.

6. Adjust cost to reflect price index, contingency and company overhead.

The description of the Budget Cost Estimates Procedures are more diverse than that for Feasibility Cost Estimates. Some respondents stated that they are using the same procedures for Feasibility Cost Estimates when developing Budget Cost Estimates. Others indicated that they use Means Manuals with some adjustments to develop Budget Cost Estimates. Finally, some of the participating (A/E) firms who are heavily involved with Saudi Aramco as a client provide estimates similar to "Expenditure Request" estimates. the procedure for "ER" estimate is used to provide Cost Estimate within $\pm$ 10% of the true cost of the projects since it is normally done when the design of the project is about 40% of the final design.

None of the participant (A/E) firms provided any variation of Budget Cost Estimate Procedures.

The participants provided some strengths and weaknesses for their Budget Cost Estimate methods. They are as follow:

Strengths:

1. Fairly accurate
2. Easy to understand
3. Easy to follow
4. Satisfies clients

5. Uses historical data which is available in house.
6. Enhance cooperation between disciplines and technical department.
7. Enables cost of different design schemes to be monitored throughout the design development.
8. Data used is from constructed projects.
9. Factual
10. Hands on
11. Project specific
12. Customized to standard projects
13. Follows market trends
14. Consistent

Weakness

1. Time consuming
2. Procedure is not computerized
3. Depends on estimator's ability to interpret requirements correctly.
4. Labor intensive.
5. Costly
6. Difficult to check and update

Table 4.39. The Procedures and Characteristic of Budget Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Budget Estimates	1	- List and group activities from tender documents - Develop work breakdown and allocate resources - Reflect contingency and escalation - Compile to give complete cost	No	- Fairly accurate - Easy to understand - Easy to follow	- Consumes time
	2	- This is an "ER" estimate developed in accordance with Saudi Aramco Estimating Procedure. It is basically the determination of cost of construction (Unit size plus major equipment or special requirements, cost of management and contingency.	No	- Satisfies our client	- None
	3	- Determine material/ equipment takes off's Get prices from vendor or historical data Determine cost of construction from scope of work, specifications, and drawings.	No	- Historical data - available in house. - Ease in obtaining budgeting prices from vendors. - Allow for good material take off's. - Provide for cooperation between technical department.	- Procedure is not computerized.

Table 4.39. The Procedures and Characteristic of Budget Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Budget Estimates	4	- By using gross floor area based cost plans by splitting the building into number of components determined from schematic drawings and priced based on cost/m2 from in house analysis of previous projects. All elements are added to give the total cost estimate.	No	- Enable cost of schemes to be monitored during the design. - Data used is from projects of known background.	- Approach depends on estimator's ability to interpret requirements accurately. - Approach depends on information available. Many unknown such as construction period, type of contract can affect the cost.
	5	- Use Manual's Catalog - Use Supplier's Quotations - Use data extracted from construction bids.	No	- Follow international cost estimating manuals such as means	- Local official cost data not available.
	6	- Use quotations from material suppliers and subcontractors and then follow same approach outlined for feasibility estimate.	No	- Prefixed cost - Limited changes - Less influence by the owner	- Risky if price of material goes up.

Table 4.39. The Procedures and Characteristic of Budget Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Budget Estimates	7	- Prepare bill of quantities and them price it.	No	- Factual and accurate	- None
	8	- No response	No	- No response	- No response
	9	- No response	No	- Same as for feasibility estimates	- Same as for feasibility estimates.
	12	- Develop bill of quantities from drawings then use previous records, market prices, material suppliers to determine the total cost.	No	- Factual since it depends on past records.	- None
	13	- Same procedure outlined for feasibility estimate	No	- Same as stated for feasibility estimate.	- Same as stated for feasibility estimate.

Table 4.39. The Procedures and Characteristic of Budget Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Budget Estimates	14	- Same as indicated for feasibility estimate	No	- None	- None
	15	- Determine cost of standard facility using cost/size of construction available with us. - Add cost of new requirements and equipment - Add cost of contingency and overhead	No	- Follows market trends. - Consistent	- Not automated/time consuming. - Difficult to check and update.
	16	- Determine cost of materials from suppliers quotation - Determine cost of construction labor from Means Catalog.	No	- Internationally acceptable	- Does not reflect local conditions
	17	- Use cost/unit size of construction available. - Determine cost of major equipment and special requirement. - Add contingency/price index.	No	- Enables project manager monitor cost during the design. - Data used is from constructed projects.	- Depends on expertise of estimator. - Estimate is as good as information available.

Table 4.39. The Procedures and Characteristic of Budget Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Budget Estimates	18	- Determine cost/unit area of standard facility - Develop take off quantities from design documents. - Add contingency.	No	- Use of historical data available. - Use of take off quantities prepared by our engineer. - Promotes team work.	- Not computerized - Time consuming - Not easy to check

4.5.2.2.2 Input Information

The participating (A/E) firms provided a list of information and indicated their perception of how important these items for the preparation of budget cost estimates. The list included thirteen items and the participants provided other items they believed that of importance.

Table 4.40 shows all the responses regarding the importance of information required for preparing budget cost estimates. Generally, the participants regarded all the information of some importance. Some of the participating (A/E) firms provided additional information that they believed they are of major importance as well. Among these are "availability of design drawings" and "designer recommendations".

Tables 4.41 and 4.42 show the mean response of each piece of information, the standard deviation, and the ranking. With the level of importance ranging from 1 (extreme importance) to 5 (extreme unimportance), the mean responses ranged from 1 which is extremely important to 3 which is important. The majority of the information items are located between level 2 and 3 which is between major importance and important. Table 4.42 shows the ranking of the overall selection of importance that these pieces of information have.

Table 4.40. Responses on level of importance of information required for preparing budget cost estimates.

S.N.	Type of required information for preparing budget estimates	Number of respondents who selected				
		Extreme importance	Major importance	Important	Major un-importance	Extreme un-importance
1.	Functional program of the facility	4	2	3	4	1
2.	Architectural program of the facility	0	9	2	2	1
3.	Location of the project	1	9	4	2	0
4.	Time of construction starting	3	4	8	2	0
5.	Owner's requirements	10	3	3	0	0
6.	Regulation requirements	2	10	2	2	1
7.	Zoning	1	5	10	2	0
8.	Weather	2	2	9	3	0
9.	Site conditions	8	2	6	0	0
10.	Complexity of the project	7	5	2	1	0
11.	Economic conditions	4	4	5	0	0
12.	Construction methods	5	7	3	0	0
13.	Technology requirements	2	4	7	0	0
14.	Availability of design drawings	2	0	0	0	0
15.	Designer recommendation	0	1	2	0	0

Table 4.41. Level of importance of information required for preparing budget cost estimates

S.N.	Type of information important for preparing budget cost estimates	Responses					
		Extreme importance	Major importance	Important	Major un-importance	Extreme un-importance	Mean*
1.	Functional program of the facility	4 28.6	2 14.3	3 21.4	4 28.6	1 7.1	2.71
2.	Architectural program of the facility	0 0	9 64.3	2 14.3	2 14.3	1 7.1	2.64
3.	Location of the project	1 6.3	9 56.2	4 25	2 12.5	0 0	2.44
4.	Time of construction starting	3 17.6	4 23.5	8 47.1	2 11.8	0 0	2.53
5.	Owner's requirements	10 62.5	3 18.7	3 18.7	0 0	0 0	1.56
6.	Regulation requirements	2 11.7	10 59	2 11.7	2 11.7	1 5.9	2.41
7.	Zoning	1 5.6	5 27.8	10 55.5	2 11.1	0 0	2.72
8.	Weather	2 12.5	2 12.5	9 56.3	3 18.5	0 0	2.81
9.	Site conditions	8 50	2 12.5	6 37.5	0 0	0 0	1.13
10.	Complexity of the project	7 43.8	5 31.2	2 12.5	2 12.5	0 0	1.94
11.	Economic conditions	4 30.8	4 30.8	5 38.4	0 0	0 0	2.08
12.	Construction methods	5 33.3	7 46.7	3 20	0 0	0 0	1.87
13.	Technology requirements	2 15.4	4 30.8	7 53.8	0 0	0 0	2.38
14.	Quality of design drawings	2 100	0 0	0 0	0 0	0 0	1
15.	Designer recommendations	0 0	0 0	2 100	0 0	0 0	3

* Ranges from 1 (extreme importance) to 5 (extreme unimportance).

Table 4.42. Level of importance of information required for preparing budget cost estimates.

S.No.	Type of information important for preparing budget cost estimates	Mean* responses	Standard deviation	Rank
1	Functional program of the facility	2.71	1.31	12
2	Architectural program of the facility	2.64	3.57	11
3	Location of the project	2.44	3.66	8
4	Time of construction starting	2.53	3.12	9
5	Owner's requirements	1.56	4.48	10
6	Regulation requirement	2.41	3.17	7
7	Zoning	2.72	4.16	13
8	Weather	2.81	3.42	14
9	Site conditions	1.13	4.31	2
10	Complexity of the project	1.94	3.11	4
11	Economic conditions	2.08	2.48	5
12	Construction methods	1.87	3.33	3
13	Technology requirements	2.38	2.98	6
14	Quality of design requirements	2.38	1.12	1
15	Designer recommendations	3	3.04	15

*Ranges from 1 (extreme importance) to 5 (extreme unimportance).

In order to make the level of importance of types of information required for preparation of budget cost estimates more visible, the positive responses (extreme importance and major importance) and the negative responses (extreme unimportance and major unimportance) were segregated from neutral responses. Table 4.43 and Figures 4.17 and 4.18 show the proportions of extreme and neutral responses after the segregation is performed. Figure 4.17 shows general shift of (A/E)

responses toward the positive side with an average positive response of 56.43% and average negative response of 9.41%. The average neutral response is 34.16% which indicates that the participating (A/E) firms selected the neutral position by over one third of the responses and the remaining two third chose the extreme responses for their opinion of how important the list of information required for preparing budget cost estimates.

Table 4.43. Proportions of extreme and neutral responses (%) of information required for preparing budget cost estimates.

S.No.	Types of information important for preparing budget cost estimates	% of extreme responses		% of neutral responses
		Positive	Negative	
1.	Functional program of the facility	42.9	35.7	21.4
2.	Architectural program of the facility	64.3	21.4	14.3
3.	Location of the project	62.4	12.5	25
4.	Time of construction starting	41.1	11.8	47.1
5.	Owner's requirements	81.2	0	18.7
6.	Regulation requirements	70.7	17.6	11.7
7.	Zoning	33.4	11.1	55.5
8.	Weather	25	18.5	56.3
9.	Site conditions	62.5	0	37.5
10.	Complexity of the project	75	12.5	12.5
11.	Economic conditions	61.6	0	38.4
12.	Construction methods	80	0	20
13.	Technology requirements	46.2	0	53.8
14.	Quality of design drawings	100	0	0
15.	Designer recommendation	0	0	100

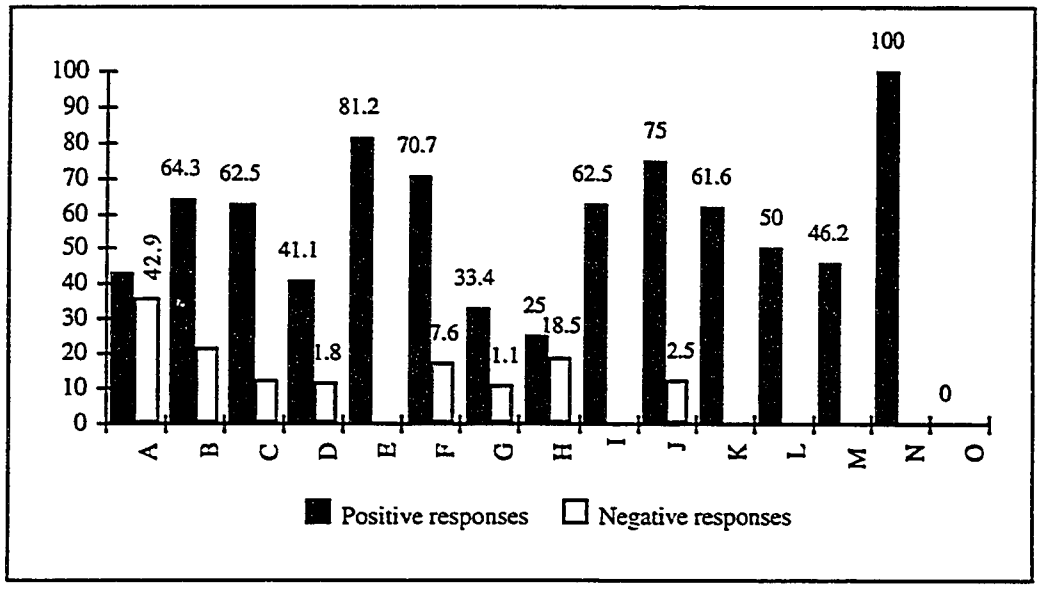


Figure 4.17. Extreme responses for the level of importance of information used for preparing budget cost estimates.

where,

A: Functional program of the facility
B: Architectural program of the facility
C: Location of the project
D: Time of construction starting
E: Owner's requirements
F: Regulation requirements
G: Zoning
H: Weather
I: Site conditions
J: Complexity of the project
K: Economic conditions
L: Construction methods
M: Technology requirements
N: Quality of design drawings
O: Designer recommendation

Figure 4.17 shows that the participants considered the "Architectural program of the facility", " the location of the project", " the owner's requirement", "the regulation requirements", "the site conditions", "the complexity of the project", the economic conditions", and the "quality of design drawings" of major important. The "Architectural program of the facility" is considered importance due to its role in defining the scope of the project. The importance of the regulation and owner's requirements arise from the need to have the project developed to the needs of authorities who is going to operate it and control it. The information regarding site conditions, complexity of the project, and economic conditions are considered important due to their significant cost impact. All the results are considered reasonable. Information such as "construction materials" and "design recommendations" were expected to be of importance due to their impact on the cost and quality of the project.

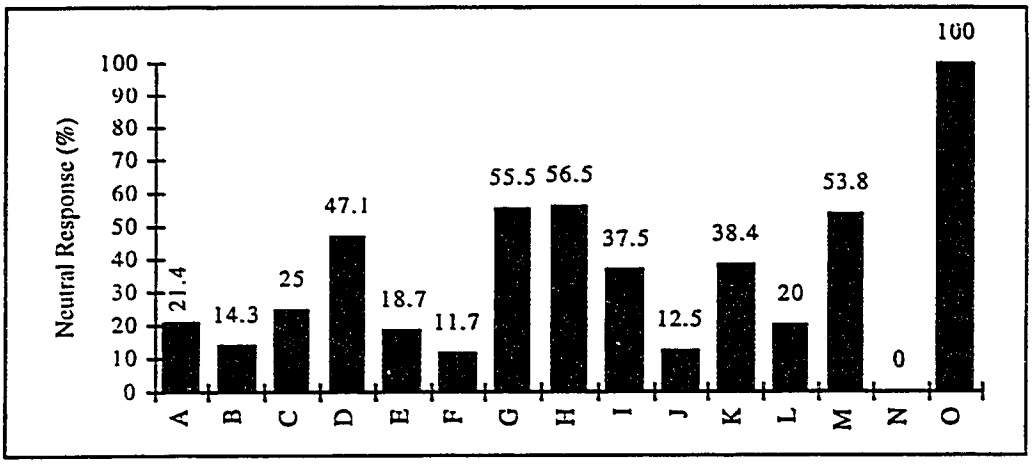


Figure 4.18 Neutral attitude towards the level of importance of information used for preparing budget cost estimates.

Where,

A: Functional program of the facility
B: Architectural program of the facility
C: Location of the project
D: Time of construction starting
E: Owner's requirements
F: Regulation requirements
G: Zoning
H: Weather
I: Site conditions
J: Complexity of the project
K: Economic conditions
L: Construction methods
M: Technology requirements
N: Quality of design drawings
O: Designer recommendation

4.5.2.2.3 Cost Information

Table 4.44 and Figure 4.19 show all the responses regarding cost information required for development of budget cost estimates. All cost information were selected by some respondents. Items such as labor cost, material cost, machine cost, management cost, escalation cost, and unit cost per area of construction were selected by a least 12 out of 16 respondents the total number of respondents. Some participating (A/E) firms indicated that additional cost information such as contingency, market trend, vendors quotations, and transportation cost are ,also, required. All these items are legitimate ones except vendors quotation which was mentioned in the original list by material cost.

Table 4.44: Cost information used for preparing budget cost estimates.

S.No.	Information used for preparing budget estimates	Respondents																Frequency	Percent
		1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18		
a	Labor cost	x	x	x		x	x		x	x	x	x	x		x		x	12	75
b	Material cost	x	x	x		x	x	x	x	x	x	x	x		x		x	13	81.3
c	Machine cost	x	x	x		x	x		x	x	x	x	x		x		x	12	75
d	Management cost	x	x	x		x	x	x		x	x	x	x	x			x	12	75
e	Escalation cost	x	x	x		x	x			x	x	x	x	x	x		x	12	75
f	Interest rate	x		x	x	x				x	x	x	x		x	x		10	62.5
g	Cost index	x		x	x		x					x	x			x	x	10	62.5
h	Price index	x	x	x	x		x					x	x			x	x	9	56.3
I	Unit cost per area of construction	x		x	x	x	x	x	x	x	x			x	x	x	x	13	81.3
j	Prices for engineered equipment																x	1	6.3
k	Contingency															x		1	6.3
l	Market trend						x											1	6.3
m	Vendor quotations			x														1	6.3
n	Transportation cost	x																1	6.3

N = 14

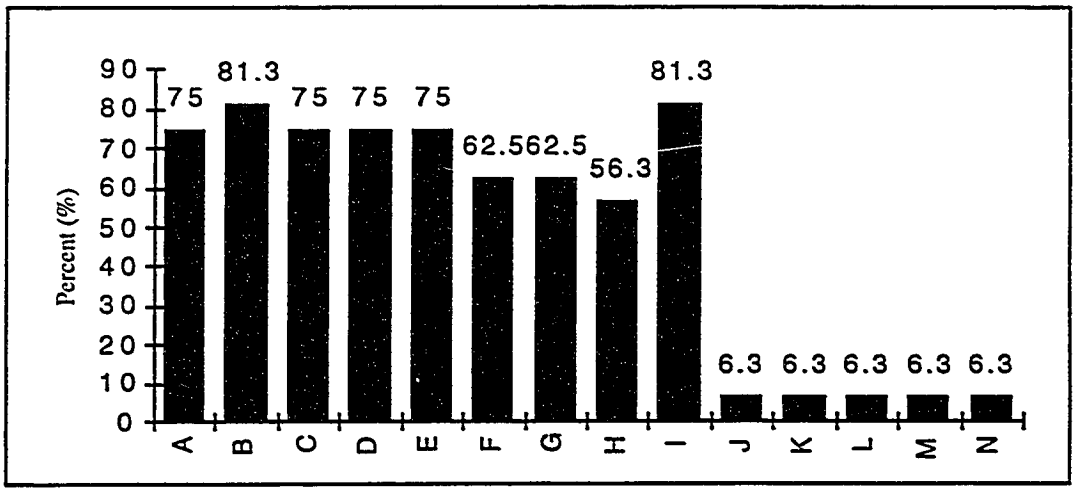


Figure 4.19. Cost information used in preparing budget cost estimates.

Where,

A: Labor cost
B: Material cost
C: Machine cost
D: Management cost
E: Escalation cost
F: Interest rate
G: Cost index
H: Price index
I: Unit cost per area of construction
J: Prices for engineered equipment
K: Contingency
L: Market trend
M: Vendor quotations
N: Transportation cost

4.5.2.2.4 Source of Cost Information

The sources of cost information required for the development of budget cost estimates and the proportions of usage of these sources and others that were provided by participants are shown in Table 4.45 Every source was selected by some of the participants. Other means of acquiring cost information such as "quotations from suppliers", "previous contracts", "market prices", and "construction contractors" were suggested by some participants to be other sources of cost information. All suggested items are considered legitimate sources although "previous contracts" was referred to by "own historical records". Suggestion that construction contractors is one source of cost information was, also, made previously when the analysis of feasibility cost estimate was made.

Table 4.45 shows that "own historical record" and "standard manuals" are the most common sources of cost information due to their reliability and being comprehensive compared to other sources. In addition, "quotation from suppliers" seemed to be somewhat common source of cost information for preparing Budget Cost Estimate due to its accuracy.

Table 4.45. Sources of cost information for budget cost estimates.

S.No.	Sources of cost information for budget cost estimates	Respondents																Frequency	Percent
		1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18		
a	Own historical records	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	45.7
b	Standard manuals	x		x		x				x	x	x	x		x		x	9	25.7
c	Quotation from suppliers	x		x					x								x	4	11.4
d	Previous contracts		x		x													2	5.7
e	Market prices						x	x						x				3	8.6
f	Construction contractors								x									1	2.8
																		35	100

N = 14

4.5.2.2.5 Updating of Cost Information

For budget cost estimates, at least ten out of sixteen (A/E) participants stated that all cost information are ought to be updated as shown in Table 4.46. None of the respondents provided any cost information that might be updated.

Seven out of sixteen respondents indicated that they provide adjustments to contingency while twelve out of sixteen respondents indicated that they provide adjustments to cost trending and ten out of fifteen indicated that they provide adjustments to construction prorates. Table 4.47 shows the frequency of updating cost information for the preparation of budget cost estimates The frequency of adjustments varied widely. None of the frequencies of updating provided seem to be performed more often than the others except in the adjustments of cost trending and construction prorates. Seven out of twelve respondents indicated that they make adjustments to cost trending annually and five out of ten respondents indicated that they make adjustments to construction prorates annually too. The difference in the frequencies of adjustments to cost information is expected since the participants have different commitments to the integrity and accuracy of Budget Cost Estimates. Additionally, there are no set adjustment frequencies to these cost information in the technical or practical sense although annual adjustments are the most common.

Table 4.46. Cost information to be adjusted for budget cost estimates.

S.No.	Cost information required for adjustment of budget estimates	Respondents																Frequency	Percent
		1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18		
a	Contingency	x	x	x		x	x	x		x		x	x	x	x	x	x	13	81.3
b	Cost trending	x	x	x		x	x			x	x	x	x	x	x		x	12	75
c	Construction prorates		x		x	x	x		x		x			x	x	x	x	10	62.5

N=16

Table 4.47. Frequency of updating cost information for budget cost estimates.

S. No	Items required to be updated for budget estimates	Respondents updating and frequency of updating																Frequency of adjustment	Frequency of non adjustment
		1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18		
a	Contingency	Yes annualy	Yes	No	No	No	Yes seldom	Yes semi annualy	No	Yes as required	No	No	Yes yearly	No	No	Yes always	No	7	9
b	Cost trending	Yes annualy	Yes	Yes yearly	No	Yes yearly	Yes often	No	No	Yes	Yes 4-6 time yearly	Yes	Yes yearly	Yes yearly	Yes Yearly	No	Yes yearly	12	4
c	Construction prorates	No	Yes	No	Yes when reqd.	Yes early	Yes yearly	No	Yes	No	Yes 4 times year	No	Yes yearly	Yes yearly	Yes yearly	Yes when required	Yes	10	5

a. No—9
   Yes—7
   - 1 always
   - 2 (annually)
   - 1 (seldom)
   - 1(as required)
   - 1 (semi annually)
   - 1 (No response)

b. No—4
   Yes—12
   - 7 (yearly)
   - 1 (often)
   - 1 (4-6 times/year)
   - 3 (No response)

c. No—5
   Yes—10
   - 5 (yearly)
   - 2 (when required)
   - 1 (4 times/year)
   - 2 (No response)

4.5.2.2.6 Use of Computers

Most of the participating (A/E) firms indicated that they use computers in developing budget cost estimates. In addition, most of the participants provided the name of computer systems used as indicated in Table 4.48. Twelve out of sixteen participants stated that they use computer systems to develop budget cost estimates. Seven out of twelve respondents indicated that they use spread sheets, one uses lotus 123, one uses estimate write, and three declined to name the computer system used.

Table 4.48. The use of computers for the development of budget cost estimates.

Type of estimate	Respondents updating and frequency of updating																Yes	No	Total
	1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18			
Budget Estimates	Yes Excel	Yes (NR)	Yes (SS)	Yes (NR)	Yes (SS)	No	Yes (SS)	Yes (NR)	Yes (Lotus 123)	Yes (NR)	No	Yes (estimate writer)	No	Yes (SS)	Yes (SS)	Yes (SS)	12	4	16

A: Use of computer for feasibility estimates

No—4
Yes—12 Spread sheet (SS)-7
Lotus 123-1
Estimate write-1
No response (NR)-3

4.5.2.2.7 Level of Satisfaction With the Characteristics of Estimating Systems

Table 4.49 shows all responses regarding the level of satisfaction with the characteristics of cost estimating systems for Budget Cost Estimates. In general, the participants were moderately satisfied with these characteristics. None of the respondents provided any additional characteristics that he is satisfied with.

Tables 4.50 and 4.51 show the level of satisfaction with the characteristics of estimating systems, the mean responses, the standard deviation, and the ranking. With the level of satisfaction ranging from 1 (extreme satisfaction) to 5 (extreme dissatisfaction), the mean responses ranged from 1.88 which is close to major satisfaction to 2.69 which is approximately half way between major satisfaction and fair satisfaction. The majority of characteristics means are located between 2 (major satisfaction) and 3 (fair satisfaction) Table 4.51 shows the ranking of the overall selection of satisfaction that these characteristics have.

In order to present the level of satisfaction with the characteristics of cost estimating systems more visible, the positive responses (extreme satisfaction and major satisfaction) and the negative responses (extreme dissatisfaction and major dissatisfaction) are segregated from neutral responses.

Table 4.49. Responses on level of satisfaction with the characteristics of estimating systems used for budget cost estimate

S. No	Characteristics of Estimating Systems Used for Budget Estimates	No. of respondent who selected				
		Extreme Satisfaction	Major Satisfaction	Fair Satisfaction	Major dis-Satisfaction	Extreme dis-atisfaction
1.	Reliable	4	10	2	0	0
2.	Easy to use	4	6	6	0	0
3.	Easy to update	4	3	8	1	0
4.	Easy to understand the output	4	6	7	0	0
5.	Compatible with MIS in your firm	1	6	7	1	1
6.	Provide accurate results	2	7	7	0	0
7.	Compatible with the technical capabilities that your firm has	6	4	7	0	0
8.	Easy to adjust to meet changes in parameters	7	0	9	0	0
9.	Comprehensive to all different type of construction projects.	4	5	6	1	0

Table 4.50. Level of satisfaction with the characteristics of estimating systems used for budget cost estimates.

		Responses					
S.N.	Characteristics of estimating systems used for budget estimates	Extreme satisfaction	Major satisfaction	Fair satisfaction	Major dis-satisfaction	Extreme dis-satisfaction	Mean*
1.	Reliable	4 25	10 62.5	2 12.5	0 0	0 0	1.88
2.	Easy to use	4 25	6 37.5	6 37.5	0 0	0 0	2.13
3.	Easy to update	4 25	3 18.7	8 50	1 6.3	0 0	2.38
4.	Easy to understand the output	4 26.7	6 40	5 33.3	0 0	0 0	4.47
5.	Compatible with MIS in your firm	1 26.7	6 37.4	7 43.7	1 6.3	1 6.3	2.69
6.	Provide accurate results	2 12.5	7 43.7	7 43.8	0 0	0 0	2.31
7.	Compatible with the technical capabilities that your firms has	6 35.3	4 23.5	7 41.2	0 0	0 0	2.06
8.	Easy to adjust to meet changes in parameters	7 43.7	0 0	9 56.3	0 0	0 0	2.13
9.	Comprehensive to all different types of construction projects	4 25	5 31.3	6 37.5	1 6.2	0 0	2.25

* Ranges from 1 (extreme satisfaction) to 5 (extreme Dissatisfaction).

Table 4.51. Level of satisfaction with the characteristic of estimating system used for budget cost estimates

#	Characteristics of Estimating Systems Used for Budget Estimates	Mean*	Standard Deviation	Rank
1.	Reliable	1.88	4.40	8
2.	Easy to use	2.13	3.26	6
3.	Easy to update	2.38	3.25	3
4.	Easy to understand the output	4.47	3.27	1
5.	Compatible with MIS in your firm	2.69	3.72	2
6.	Provide accurate results	2.31	3.70	4
7.	Compatible with the technical capabilities that your firm has	2.06	3.61	7
8.	Easy to adjust to meet changes in parameters	2.13	4.55	6
9.	Comprehensive to all types of construction projects.	2.25	2.79	5

* Ranges from 1 (Extreme Satisfaction) to 5 (Extreme Dissatisfaction)

Table 4.52 and Figures 4.20 and 4.21 show the proportions of extreme and neutral responses after the segregation is made. Figure 4.20 show major shift of responses toward the positive side with an average responses of 57.68% and average negative responses of 2.8%. The average neutral response is 39.52% which indicate that the respondents slightly chose to maintain neutral attitude when selecting the level of satisfaction with the characteristic of estimating systems for Budget Cost Estimates.

Table 4.52. Proportions of extreme and neutral responses (%) of characteristics of estimating systems used for budget cost estimates.

#	Characteristics of Estimating Systems Used for Budget Estimates	% of Extreme Responses		% of Neutral Responses
		Positive	Negative	
1.	Reliable	87.5	0	12.5
2.	Easy to use	62.5	0	37.5
3.	Easy to update	43.7	6.3	50
4.	Easy to understand the output	66.7	0	33.3
5.	Compatible with MIS in your firm	43.7	12.6	43.7
6.	Provide accurate results	56.3	0	43.7
7.	Compatible with the technical capabilities that your firm has	58.8	0	41.2
8.	Easy to adjust to meet changes in parameters	43.7	0	56.3
9.	Comprehensive to all types of construction projects.	56.2	6.3	37.5

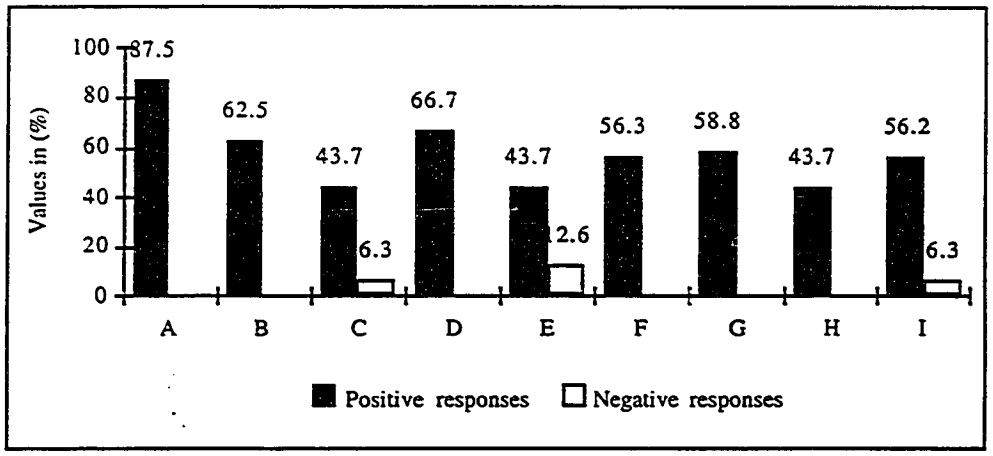


Figure 4.20. Extreme responses for the of satisfaction with the characteristics of estimating systems for budget estimates.

Where,

A: Reliable
B: Easy to use
C: Easy to update
D: Easy to understand
E: Compatible with MIS in your firm
F: Provide accurate results
G: Compatible with the technical capability that your firms have
H: Easy to adjust to meet changes in parameters.
I: Comprehensive to all types of construction projects.

The characteristics of estimating systems for budget cost estimate such as reliability, easy to use, easy to understand the output, and providing accurate results are consistent with the participant's earlier indication on the strength of budget cost estimates discussed in section 5.4.2.2.1. However, characteristics such as being compatible with the technical capabilities that their firms have and being comprehensive to all types of construction projects which the participants indicated their satisfaction with were not considered earlier as strengths of budget cost estimates. In

addition, the participants were neutral about item C, easy to update, although the participants considered it earlier as a weakness of budget cost estimates.

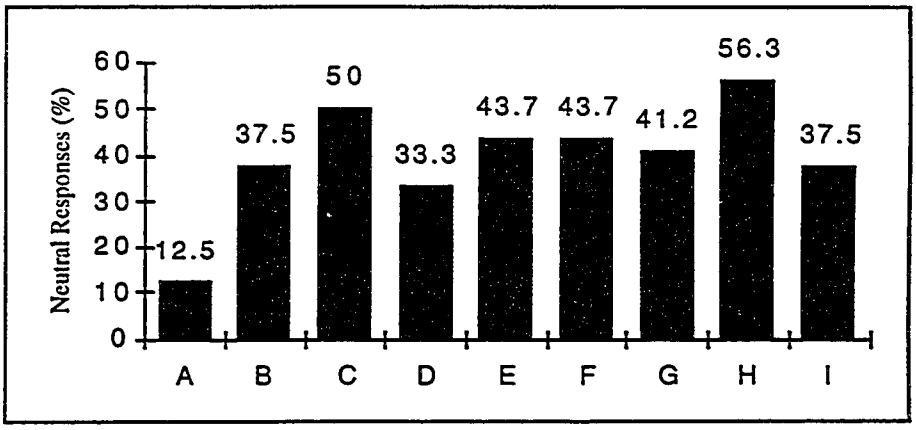


Figure 4.21. Neutral attitude towards the characteristics of estimating systems used for budget estimates.

where,

A: Reliable
B: Easy to use
C: Easy to update
D: Easy to understand and the output
E: Compatible with MIS in your firm
F: Provide accurate results
G: Compatible with the technical capability of that your firm has
H: Easy to adjust to meet changes in parameters
I: Comprehensive to all types of construction projects

4.5.2.2.8 Reliability of Budget Cost Estimating System

The participating (A/E) firms provided budget cost estimates of projects that were designed and supervised during the last five years. In addition, the participants provided the corresponding bid prices for these projects. The purpose behind exhibiting these estimates and bid prices is to determine the variances between values of different cost estimates and bid prices which, in turn, will provide good and measurable scale of how good are these cost estimates compared with the bid prices, the true costs. Some of the participants, however, declined to provide such information claiming that it is restricted and clients do not allow the disclosure of such information. As a solution, it was recommended to respondents to provide an average variance between the cost estimate values and the bid prices for previous projects. After further reluctance, the participants provided these variances. It is needless to say that the responses are considered the most vital since it provides true and precise method of evaluating the quality of developed budget cost estimates. There were cases where participating (A/E) firms provided bid prices of performed projects prior to the evaluation and determination of the contract values. In these cases, it was assumed that the bid price is the lowest of these bidding values.

Technically, it has been determined that budget cost estimates are ± 20% of the bid price (Adrian, 1982).

Table 4.53. The overall average of the average variances between budget cost estimate and bid prices.

Respondents	Average variance between budget estimates and bid prices (±%)
1	22
2	10
3	12.3
4	14.7
5	8.7
6	3
7	5.3
8	18
9	15
12	13.3
13	15
14	20
15	15
16	15
17	15
18	15
	average ±13.6%

Table 4.53 shows that the overall average of the average variances between budget cost estimates and bid prices to be ± 13.6% compared with ± 20%. This result is very encouraging result.

4.5.2.3 Design Cost Estimates

Table 4.22 shows the proportion of participating (A/E) firms who develop Design Cost Estimates as part of their engineering services. The result shows that Design Cost Estimating is practiced by 87.5% of the participating (A/E) firms. It is considered, alongwith Budget Cost Estimating, the most commonly provided. the popularity of Design Cost Estimating comes as a result of the clients demand for this type of estimate.

4.5.2.3.1 Procedures and Characteristics

Table 4.54 shows the procedures, the variation to the procedures, and the characteristics of Design Cost Estimates as viewed by participating (A/E) firms. Although fifteen out of eighteen participants indicated that they provide Design Cost Estimates, only fourteen (A/E) firms provided outline of their procedures and their characteristics.

In general, the participants use the following procedures to develop Design Cost Estimate:

1. Develop list of activities and separate work by disciplines individual estimates.

2. Develop Bill of quantities for materials, labor and equipment

3. Obtain prices of materials from suppliers

4. Determine cost of labor and equipment from records of previous projects.

5. Add cost of project management, contingency and price index.

The responses regarding the Design Cost Estimates Procedures are diverse in terms of specific steps of methods followed and the degree of precessions used to determine the overall cost. Some of the respondents indicated that they are using the same method previously used for feasibility and budget cost estimates. It is believed that the outcome of using the same method will not provide an adequately accurate estimate. It will generate estimate of at least 20-30% of the true estimate. Also, some of the participants used somewhat the above mentioned method in conjunction with Means Manual for determination of material and labor cost. The degree of accuracy of this method is unknown since it depends on the expertise of the estimator in using the proper factors to covert international material and labor costs to local ones. finally, some respondents indicated that they develop Design Cost Estimate using Saudi Aramco "ER" estimate format which may not provide estimate of acceptable accuracy since this method of estimating is designed for conceptual design where the engineering work is only 40% of the final design.

None of the (A/E) firms indicated that they use variations to Design Cost Estimate.

The participants provided some characteristics for their corresponding Design Cost Estimating Procedures. Some of the mostly common are as follows:

Strengths

1. Accurate and Factual
2. Considers all cost aspects
3. Satisfies clients
4. All technical disciplines are involved from the beginning of the design process.
5. Availability of historical data
6. Makes monitoring of cost easy
7. Cost can be determined at interim stages of the design
8. Enables comparison with other schemes or designs
9. Hand on due to it practicality
10. Project specific by considering specific scope
11. Customized to standard projects
12. Simple due to the inexistence of hard computation

13. The use of the procedure outlined earlier makes the development of the estimate fast.

14. Somewhat easy to use

15. Consistent in providing results from one project to another

16. Enables monitoring of cost throughout design process

17. Encourages team work

Weaknesses

1. Takes time to reflect adjustments

2. Only limited to similar projects where historical data is available

3. Not automated

4. Difficult to check or update

From the previous discussion of methods and characteristics of Feasibility, Budget and Design Cost Estimate, it is noticed that the procedures of the three stages of project development are similar in terms of process and the only difference is the level of engineering details. The estimator basically is required to list all available details then price them using quotation from suppliers, historical data, or international manuals. In additions, some variables such as cost of project management, contingency, price index and overhead are added. Same thing can be said about characteristics where the different cost estimates procedures have similar

strengths and weaknesses except for slight changes that have something to do with level of details that a procedure has.

Table 4.54: The Procedures and Characteristic of Design Cost Estimates

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Design Estimates	1.	- Develop list of activities - Develop list of manpower and man hours required - Obtain labor cost - -Reflect the contingency to get total cost - Put all cost together to get total cost	No	- Accurate - Considers all cost aspect - Floor proof system.	- Time continuing. - Takes time to carry out adjustments.
	2	- Basically is an "ER" estimate estimate - Aramco approach of developing estimates. It is as accurate as the information available.	No	- As stated in the Budget Estimate Section.	- As stated in Budget Estimate Section.
Design Estimates	3	- Separate work by discipline - Individual estimate - Prices from quotation and records - Extract data from design drawings and specifications. - Add cost of project management, supervision.	No	- Analysis is complete. - All technical disciplines are involved from the beginning. - Availability of historical data.	- Difficult to adjust for changes in scope.
	4	- Obtain information from drawings such as plans, elevations, sectors and site plans. - Use guidance information list (at budget stage). - Clients requirements checklist at 15%, 30%, 90% design stages. - Price BOQ at final stage (100%)	No	- Easy monitoring of cost. - Cost can be determined at interim stages of design,. - Bill of quantities ensures inclusion of all costs. Enables comparison - with other schemes or designs.	- Unavailability of local cost information.

Table 4.54. The Procedures and Characteristic of Design Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Design Estimates	5	- Develop material take off's from project drawings. - Use Means Catalog. - Use quotation from suppliers - Use recent bid prices	No	- Same as outlined in the Budget Estimate Section.	- Same as stated in the Budget Estimate Section.
	6	- Develop and price BOQ Use past information of projects especially for labor costs.	No	- Accurate	- Have lengthy procedures.
	7	- Develop BOQ - Get market prices for materials - Get labor costs - Reflect changes in laws that may impact cost.	No	- Factual - Accurate	- None
	8	- No response	No	- No response	- No response
Design Estimates	9	- No response	No	- As stated in Budget Estimate Section	- As stated in Budget Estimate Section
	13	- Based on quotes form vendors, previous projects, and experience,. It gives ± 5% accuracy.	No	- As outlined in Budget Estimate Section	- As outlined in Budget Estimate Section
	14	- As outlined in "Feasibility Estiamte" Section.	No	- As indicated in "Feasibility Estimate " Section.	- As indicated in "Feasibility Estimate " Section.
	15	- Determine materials and labor breakdown from design document. Determine cost form previous projects. - Determine overhead and contingency costs.	No	- Somewhat accurate - Consistent	- Time consuming - Difficult to check or update.

Table 4.54. The Procedures and Characteristic of Design Cost Estimates.

Type of Estimate	Respondent	Procedures	Other Variations	Strengths	Weaknesses
Design Estimates	16	- Develop material take off from design drawings - Use rates from "Means" Catalog - Add prices from suppliers quotation - Add cost for management/labor cost - Add allowance for contingency	No	- As stated in the "Budget Estimate" section.	- As stated in Budget Estimate Section
	17	- Extract information from drawings, specification, client's requirements. - Obtain labor, materials, and equipment cost from vendors and past records. - Add overhead and contingency	No	- Enables monitoring of cost during design process. - Interim cost can be determined. - Reliable if the BOQ is reliable.	- Time consuming to check/update. - Depends on the expertise of the estimator.
	18	- Determine materials and equipment take off list - Determine the cost of material, equipment, and labor - Add management, overhead, and contingency cost.	No	- Established by our own staff. - All technical disciplines are involved from the start. - Encourages team work	- Time consuming - Not automated - Difficult to check

4.5.2.3.2 Input Information

The participating (A/E) firms provided a list of information and stated their perception of how important these items for the preparation of design cost estimates. The list included thirteen items and the participants were given the choice to provide other items that may be of importance.

Table 4.55 shows all the responses regarding the importance of information required for preparation of design cost estimates. Generally, the participants regarded all the items of some importance. Some of the participating (A/E) firms provided additional items that they believed they are of importance. Among these are quality of design drawings and chance of changes.

Tables 4.56 and 4.57 show the mean responses of each piece of information, the standard deviation, and the ranking. With the level of importance ranging from 1(extreme importance) to 5 (extreme unimportance). The mean values ranged from 1.47 which is near half way between extreme importance and major importance to 3 which is important. The majority of information are located between level 2 and 3 which is between major importance and important. Table 4.57 shows the ranking of the overall selection of importance that these pieces of information have.

Table 4.55. Responses on level of importance of information required for preparing design cost estimates.

S.N.	Type of required information for preparing design estimates	Number of respondents who selected				
		Extreme importance	Major importance	Important	Major un-importance	Extreme un-importance
1.	Functional program of the facility	2	3	3	4	1
2.	Architectural program of the facility	1	5	3	5	1
3.	Location of the project	5	2	7	2	0
4.	Time of construction starting	3	5	7	0	0
5.	Owner's requirements	11	1	3	0	0
6.	Regulation requirements	3	7	4	1	0
7.	Zoning	2	4	5	3	0
8.	Weather	2	1	10	2	0
9.	Site conditions	5	0	10	0	0
10.	Complexity of the project	4	5	4	2	0
11.	Economic conditions	3	4	6	2	0
12.	Construction methods	3	4	6	1	0
13.	Technology requirements	5	2	8	0	0
14.	Quality of design drawings	0	1	0	0	0
15.	Chances of changes	0	1	0	0	0

Table 4.56. Level of importance of information required for preparing design cost estimates

S.N.	Type of information important for preparing design cost estimates	Responses					
		Extreme importance	Major importance	Important	Major un-importance	Extreme un-importance	Mean*
1.	Functional program of the facility	2 15.4	3 23.1	3 23.1	4 30.8	1 7.6	2.91
2.	Architectural program of the facility	1 6.7	5 33.3	3 20	5 33.3	1 6.7	3.00
3.	Location of the project	5 31.3	2 12.5	7 43.7	2 12.5	0 0	2.37
4.	Time of construction starting	3 20	5 33.3	7 46.7	0 0	0 0	2.27
5.	Owner's requirements	11 73.3	1 6.7	3 20	0 0	0 0	1.47
6.	Regulation requirements	3 20	7 46.7	4 26.7	1 6.6	0 0	2.20
7.	Zoning	2 14.3	4 28.6	5 35.7	3 21.4	0 0	2.64
8.	Weather	2 13.3	1 6.7	10 66.7	2 13.3	0 0	2.80
9.	Site conditions	5 33.3	0 0	10 66.7	0 0	0 0	2.33
10.	Complexity of the project	4 26.7	5 33.3	4 26.7	2 13.3	0 0	2.27
11.	Economic conditions	3 20	4 26.7	6 40	2 13.3	0 0	2.47
12.	Construction methods	3 21.4	4 28.6	6 42.8	1 7.2	0 0	2.35
13.	Technology requirements	5 33.3	2 13.3	8 53.4	0 0	0 0	2.20
14.	Quality of design drawings	0 0	1 100	0 0	0 0	0 0	2.20
15.	Chances of changes	0 0	1 100	0 0	0 0	0 0	2.00

* Ranges from 1 (extreme importance) to 5 (extreme unimportance).

Table 4.57. Level of importance of information required for preparing design cost estimates.

S.No.	Type of information important for preparing design cost estimates	Mean* responses	Standard deviation	Rank
1	Functional program of the facility	2.91	1.19	11
2	Architectural program of the facility	3.00	2.00	12
3	Location of the project	2.37	2.93	7
4	Time of construction starting	2.27	3.19	4
5	Owner's requirements	1.47	4.94	1
6	Regulation requirement	2.20	2.12	3
7	Zoning	2.64	1.93	9
8	Weather	2.80	4.01	10
9	Site conditions	2.33	4.53	5
10	Complexity of the project	2.27	2.16	4
11	Economic conditions	2.47	2.31	8
12	Construction methods	2.35	2.44	6
13	Technology requirements	2.20	3.58	3
14	Quality of design drawings	2.00	2.06	2
15	Chances of changes	2.00	2.06	2

*Ranges from 1 (extreme importance) to 5 (extreme unimportance).

In order to make the level of importance of types of information required for preparing design cost estimates more visible and conceivable, the positive responses (extreme importance and major importance) and the negative responses (extreme unimportance and major unimportance) were segregated from neutral responses. Table 4.58 and Figures 4.22 and 4.23 show the proportion of extreme and neutral responses after the segregation was performed. Figure 4.22 show a general shift of (A/E) responses toward the positive side with an average positive response of 54.8% and average negative response of 11.07%. The average neutral response is 34.3%. The results is somewhat similar to that of budget cost estimates which indicates that the participating (A/E) firms selected the neutral response by over one third of the responses and the remaining two thirds chose the extreme responses for their opinion of how important the list of information required for preparing design cost estimates.

Table 4.59 shows comparison between feasibility, budget and design cost estimates for the average mean, average positive responses, average negative responses, and average neutral responses. The comparison shows that as the level of details increased in a certain cost estimate, the level of importance of such information decreases. In addition, as the level of details increase in a certain cost estimate, the average positive responses decreased and the average neutral responses increases. Both cases suggest

decrease in the level of importance of such information. These findings may not be logical and one suggests that the findings should be reversed. The explanation to this is that the list of information provided to participants are dominated by one that special to feasibility and budget cost estimates more than design cost estimate.

Table 4.58. Proportions of extreme and neutral responses (%) for the level of importance of information required for preparing design cost estimates.

S.No.	Types of information important for preparing design cost estimates	% of extreme responses		% of neutral responses
		Positive	Negative	
1.	Functional program of the facility	38.5	38.5	23.1
2.	Architectural program of the facility	40	40	20
3.	Location of the project	45.8	12.5	43.7
4.	Time of construction starting	53.3	0	46.7
5.	Owner's requirements	80	0	20
6.	Regulation requirements	6.6	66.7	26.7
7.	Zoning	42.9	21.4	35.7
8.	Weather	20	13.3	66.7
9.	Site conditions	33.3	0	66.7
10.	Complexity of the project	60	13.3	26.7
11.	Economic conditions	46.7	13.3	40
12.	Construction methods	50	7.2	42.8
13.	Technology requirements	46.6	0	53.4
14.	Quality of design drawings	100	0	0
15.	Chances of changes	100	0	0

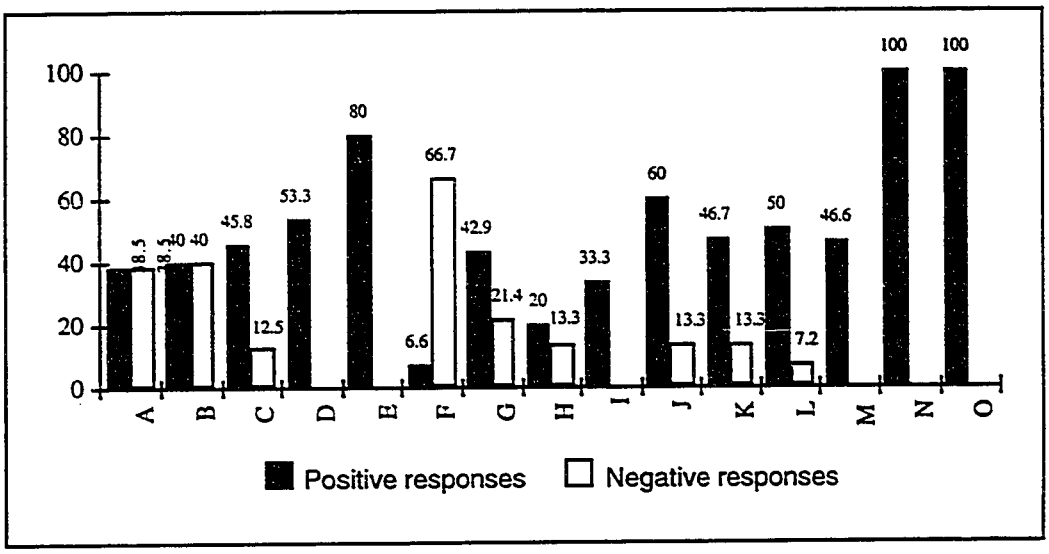


Figure 4.22. Extreme responses for the level of importance of types of information used for preparing design estimates.

A: Functional program of the facility
B: Architectural program of the facility
C: Location of the project
D: Time of construction starting
E: Owner's requirements
F: Regulation requirements
G: Zoning
H: Weather
I: Site conditions
J: Complexity of the project
K: Economic conditions
L: Construction methods
M: Technology requirements
N: Quality of design drawings
O: Chances of changes

Figure 4.22 shows that information such as "Time of construction starting", "Owner's requirements", "Complexity of the project", "Construction methods", "Quality of the design drawings", and "Chances of changes", were considered of major importance. This is logical except for

the "Complexity of the project" and the "Owner's requirements" which are supposed to be determined prior to this stage of the project. The participants did not consider "Economic conditions" of major importance although it is believed to be so.

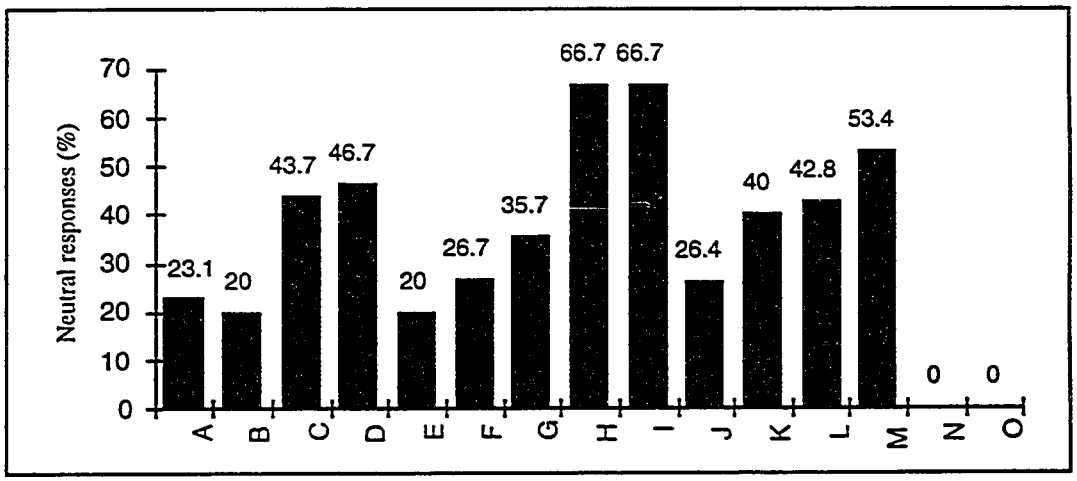


Figure 4.23. Neutral attitude towards the level of importance of types of information used for preparing design estimates.

Where,

A: Functional program of the facility
B: Architectural program of the facility
C: Location of the project
D: Time of construction starting
E: Owner's requirements
F: Regulation requirements
G: Zoning
H: Weather
I: Site conditions
J: Complexity of the project
K: Economic conditions
L: Construction methods
M: Technology requirements
N: Quality of design drawings
O: Chances of changes

Table 4.59. Comparison between different types of cost estimates regarding the level of importance of suggested information.

Types of estimate	Average mean response	Average positive response (%)	Average negative response (%)	Average neutral response (%)
Feasibility cost estimate	1.99	65.47	10.64	23.89
Budget cost estimates	2.21	56.43	9.41	34.16
Design cost estimate	2.35	54.80	11.07	34.13

4.5.2.3.3 Cost Information

Table 4.60 show all the responses regarding cost information required for development of design cost estimates. All cost information were selected by some of the participating (A/E) firms. Items such as labor cost, material cost, machine cost, management cost, and escalation cost were selected by at least 9 out of 15 respondents which is the total number of respondents. Some participants provided additional cost items that they believe they are required for the preparation of design cost estimates such as temporary construction facilities and contingency. Both items are considered legitimate cost items required for the development of design cost estimates.

Table 4.60. Cost information used for preparing design cost estimates.

S.No.	Information used for preparing design estimates	Respondents															Frequency	Percent
		1	2	3	4	5	6	7	8	9	13	14	15	16	17	18		
a	Labor cost	x	x	x		x	x	x	x	x	x	x	x	x	x	x	14	93.3
b	Material cost		x	x		x	x	x		x	x	x	x	x	x	x	12	80
c	Machine cost		x	x		x	x	x		x	x	x	x	x	x	x	12	80
d	Management cost	x	x	x		x	x	x	x	x	x	x	x	x	x	x	14	93.3
e	Escalation cost	x				x	x			x	x	x	x	x			9	60
f	Interest rate				x	x	x			x	x	x		x	x		6	40
g	Cost index	x			x		x			x		x					5	33.3
h	Price index	x		x	x		x					x	x				6	40
I	Unit cost per area of construction				x	x	x	x									4	26.7
j	Prices for engineered equipment			x													1	3.4
k	Contingency														x	x	2	6.7

N = 15

4.5.2.3.4 Sources of Cost Information

The sources of cost information required for the development of design cost estimates and the proportions of usage of these sources and others suggested by participating (A/E) firms are shown in Table 4.61. All the sources were selected by some participants. Some of the respondents suggested other means of acquiring cost information such as "quotations from vendors", "Database" and "market prices". Again, all suggested items are logical sources of information and some of them such as "quotations from vendors" and "market prices" were suggested earlier on the feasibility and budget cost estimate sections.

Table 4.61 shows that "Own historical data" and "Standard manuals" are the most common sources of cost information due to their reliability and being comprehensive compared to other sources. Additionally, "Quotation from vendors" seemed to be somewhat common for preparing design cost estimates due to its accuracy.

Table 4.61. Sources of cost information for design cost estimates.

S.No.	Sources of cost information for design cost estimates	Respondents															Frequency	Percent
		1	2	3	4	5	6	7	8	9	13	14	15	16	17	18		
a	Own historical records	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16	47.1
b	Standard manuals	x	x	x	x	x					x	x		x	x	x	10	29.4
c	Quotation from vendors						x		x		x		x				4	11.8
d	Database				x										x		2	5.9
e	Market prices		x					x									2	5.9
																	Total 34	100

N = 15

4.5.2.3.5 Updating of Cost Information

For design cost estimates, at least nine out of fifteen (A/E) participants indicated that cost information such as contingencies, cost trending, and construction prorates are ought to be updated as shown in Table 4.62 One respondent suggested that "Time Impact" should be added to these cost information.

Table 4.63 shows the frequency of updating cost information for the preparation of design cost estimates. Eight out of fifteen respondents indicated that they provide adjustments to contingency while ten out of fourteen respondents stated that they provide adjustments to cost trending and eight out of fourteen respondents stated that they provide adjustments to construction prorates. The frequencies of adjustments varied widely and none of them seem to be performed more often than the others except in the adjustment of cost trending. Six out of ten respondents indicated that they perform adjustment yearly.

The variance in the adjustment frequencies of cost information is logical since the participants have different commitments to the soundness and accuracy of Design Cost Estimates. Moreover, there are no set adjustment frequencies to these cost information in the technical or practical sense although annual adjustment are the most common.

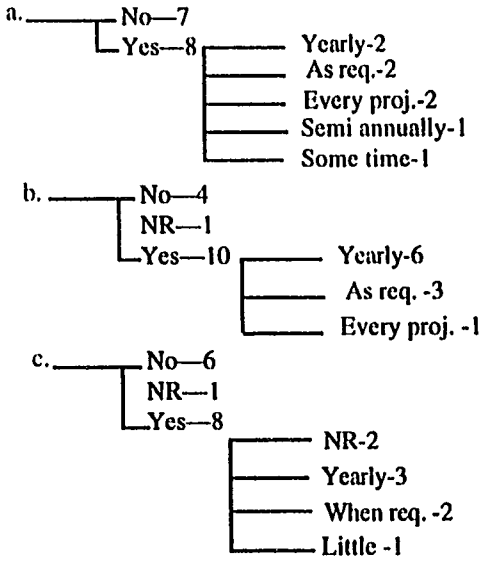
Table 4.62. Cost Information to be adjusted when preparing design cost estimates.

S.No.	Items required for adjustment of design cost	Respondents															Frequency	Percent
		1	2	3	4	5	6	7	8	9	13	14	15	16	17	18		
a	Contingency	x		x		x	x	x		x	x	x	x	x	x	x	12	80
b	Cost trending	x		x		x	x			x	x	x		x		x	9	60
c	Construction prorates	x			x	x	x		x			x	x	x	x		9	60
d	Time impact						x										1	6.7

N=15

Table 4.63. Frequency of updating cost information for design cost estimates.

S. No	Items required to be updated for design estimates	Respondents updating and frequency of updating															Frequency of adjustment	Frequency of non adjmt.
		1	2	3	4	5	6	7	8	9	13	14	15	16	17	18		
a	Contingency	Yes annualy	No	Yes as required	No	No	Yes every project	Yes semi annualy	No	Yes as required	No	Yes yearly	Yes every proj.	No	No.	No	8	7
b	Cost trending	Yes annualy	No	Yes as per reqd.	No	Yes yearly	Yes every proj.	No	No	Yes as reqd.	Yes early	Yes yearly	Yes yearly	Yes Yearly	N.R	Yes as reqd.	10	4
c	Construction prorates	No	No	No	Yes (NR)	Yes yearly	Yes yearly	No	Yes (NR)	NR	No	Yes yearly	Yes when reqd.	Yes yearly	Yes when reqd.	No	8	6



4.5.2.3.6 Use of Computers

Most of the participating (A/E) firms indicated that they use computers in developing design cost estimates as shown in Table 4.64. In addition, most of the participants named the computer system used. Seven out of twelve use spread sheets, two use lotus 123, one uses its own database, one uses estimate write, and four declined to name the computer systems used.

Table 4.64. The use of computers for the development of design cost estimates.

Type of estimate	Respondents updating and frequency of updating																Yes	No	Total
	1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18			
Design Estimates	Yes IBM (SS)	Yes (NR)	Yes (SS)	Yes (NR)	Yes (SS)	No	Yes Lotus 123	Yes Lotus 123 Excel dbase	Yes (NR)		No	Yes (estimate writer)	No	Yes (SS)	Yes (NR))	Yes (SS)	12	3	15

A: Use of computer for feasibility estimates

No—4
Yes—12 Spread sheet (SS)-7
Lotus 123-1
Estimate write-1
No response (NR)-3

4.5.2.3.7 Level of Satisfaction With the Characteristics of Estimating

Table 4.65 shows the responses regarding the level of satisfaction with the characteristics of cost estimating systems for design cost estimate. Generally, the respondents were satisfied with these characteristics. None of the respondents suggested any additional characteristics that he is satisfied with.

Table 4.66 and 4.67 show the level of satisfaction with the characteristics of estimating systems, the mean responses, the standard deviation, and the ranking. With the level of satisfaction ranging from 1 (extreme satisfaction) to 5 (extreme dissatisfaction), the mean responses ranged from 1.40 which is close to half way between extreme satisfaction and major satisfaction, to 2.31 which is between major satisfaction and fair satisfaction. The majority of the characteristics means are located between 1 (extreme satisfaction) and 2(major satisfaction). Table 4.68 show the ranking of the overall selection of satisfaction that these characteristics have.

In order to present the level of satisfaction with the characteristics of cost estimating systems more visible, the positive responses (extreme satisfaction and major satisfaction) and the negative responses (extreme dissatisfaction and major dissatisfaction) were segregated from neutral responses.

Table 4.65. Responses on level of satisfaction with the characteristics of estimating systems used for design cost estimates.

S.N.	Characteristics of estimating system used for design estimates	Number of respondent who selected				
		Extreme satisfaction	Major satisfaction	Fair satisfaction	Major dis satisfaction	Extreme dis-satisfaction
1.	Reliable	4	6	5	0	0
2.	Easy to use	5	9	2	0	0
3.	Easy to update	5	9	1	0	0
4.	Easy to understand the output	9	6	0	0	0
5.	Compatible with MIS in your firm	4	9	1	1	0
6.	Provide accurate results	4	5	4	0	0
7.	Compatible with the technical capability that your firm has	3	9	0	1	0
8.	Easy to adjust to meet changes in parameters	8	4	3	0	0
9.	Comprehensive to all different types of construction project	3	7	4	1	0

Table 4.66. Level of satisfaction with the characteristics of estimating systems used for design cost estimates.

S.N.	Characteristics of estimating systems used for design estimates	Responses					
		Extreme satisfaction	Major satisfaction	Fair satisfaction	Major dis-satisfaction	Extreme dis-satisfaction	Mean*
1.	Reliable	4 26.7	6 40	5 33.3	0 0	0 0	2.07
2.	Easy to use	5 31.3	9 56.3	2 12.4	0 0	0 0	1.81
3.	Easy to update	5 33.	9 60	1 6.7	0 0	0 0	1.73
4.	Easy to understand the output	9 60	6 40	0 0	0 0	0 0	1.40
5.	Compatible with management information system in your firm	4 26.7	9 60	1 6.7	1 6.6	0 0	1.94
6.	Provide accurate results	4 28.6	6 42.8	4 28.6	0 0	0 0	2.00
7.	Compatible with the technical capabilities that your firm has	3 21.4	10 71.4	0 0	1 7.2	0 0	1.93
8.	Easy to adjust to meet changes in parameters	8 47.1	4 23.5	3 17.6	2 11.8	0 0	1.89
9.	Comprehensive to all different types of construction projects	3 18.7	7 43.8	4 25	2 12.5	0 0	2.31

* Ranges from 1 (extreme satisfaction) to 5 (extreme dissatisfaction).

Table 4.67. Level of satisfaction with the characteristics of estimating information used for design cost estimates

S.No.	Characteristics of estimating systems used for design estimates	Mean*	Standard deviation	Rank
1	Reliable	2.07	3.01	2
2	Easy to use	1.81	4.13	7
3	Easy to update	1.73	4.18	8
4	Easy to understand the output	1.40	4.60	9
5	Compatible with management information systems that your firm has	1.94	3.86	4
6	Provide accurate results	2.00	2.82	3
7	Compatible with the technical capabilities that your firm has	1.93	4.31	5
8	Easy to adjust to meet changes in parameters	1.89	3.41	6
9	Comprehensive to all different types of construction projects	2.31	2.77	1

*Ranges from 1 (extreme satisfaction) to 5 (extreme dissatisfaction).

Table 4.68 and Figures 4.24 and 4.25 show the proportions of extreme and neutral responses after the segregation was performed. Figure 4.24 show major shift of responses toward the positive side with an average major response of 81.29% and average negative response of 4.23%. The average neutral response is 14.48% which indicates that the participants decided not to maintain positive position when selecting the level of satisfaction with the characteristics of estimating systems for design cost estimates.

Table 4.69 shows comparison between feasibility, budget, and design cost estimates for the average mean, average positive response, average negative response, and average neutral response. The comparison shows that as the level of details increases in a certain cost estimates, the level of satisfaction with the characteristics of estimating system increases. In addition, as the level of details increases in certain cost estimate, the average positive responses increases, the average negative responses decreases, and the average neutral responses decreases. These are expected results.

Table 4.68. Proportion of extreme and neutral responses (%) of the characteristics of estimating systems used for design cost estimates.

S.No.	Characteristics of estimating systems used for design estimates	% of extreme responses		% of neutral responses
		Positive	Negative	
1.	Reliable	66.7	0	33.3
2.	Easy to use	87.6	0	12.4
3.	Easy to update	93.3	0	6.7
4.	Easy to understand the output	100	0	0
5.	Compatible with management information systems in your firm	86.7	6.6	6.7
6.	Provide accurate results	71.4	0	28.6
7.	Compatible with the technical capabilities that your firm has	92.8	7.2	0
8.	Easy to adjust to meet changes in parameters	70.6	11.8	17.6
9.	Comprehensive to all different types of construction project	62.5	12.5	25

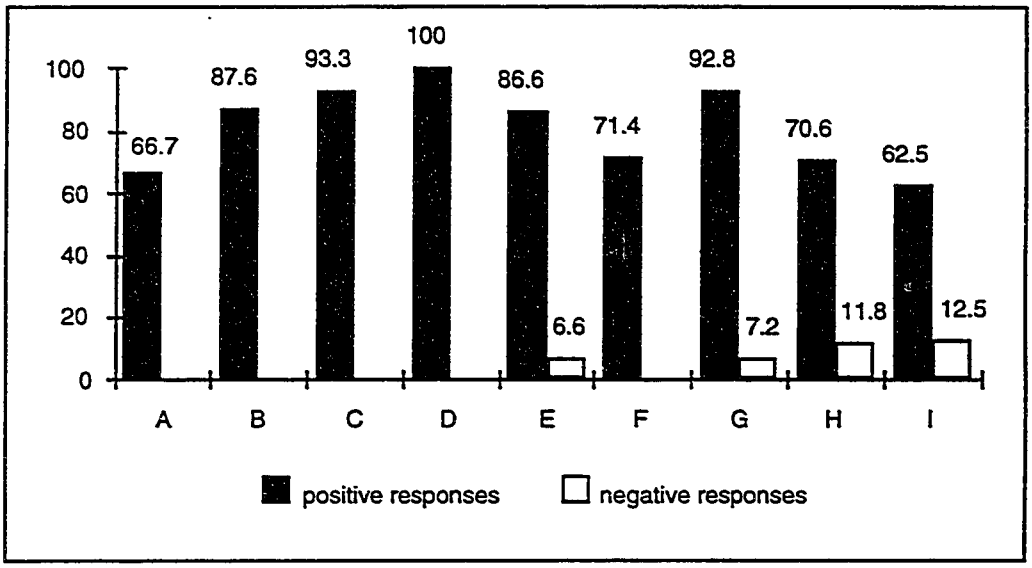


Figure 4.24. Extreme responses for the satisfaction with the characteristics of estimating systems used for design estimates.

Where,

A: Reliable

B: Easy to use

C: Easy to update

D: Easy to understand the output

E: Compatible with management information system in your firm

F: Provide accurate results

G: Compatible with the technical capabilities that your firm have

H: Easy to adjust to meet changes in parameters

I: Comprehensive to all different types of construction projects

It is evident that all the characteristics of estimating systems used for design estimates shown in figure 4.24 are consistent with the participants' earlier responses on the strengths of design cost estimates discussed in

section 5.4.2.3.1 except for the characteristics "Easy to update" which was considered as one of the weaknesses of design cost estimates. Additionally, characteristics such as "Compatible with management information system in your firm", "Compatible with the technical capabilities that your firm have", "easy to adjust to meet changes in parameters" and " Comprehensive to all different types of construction projects" which the participants indicated their satisfaction with were not considered earlier as strengths of design cost estimates.

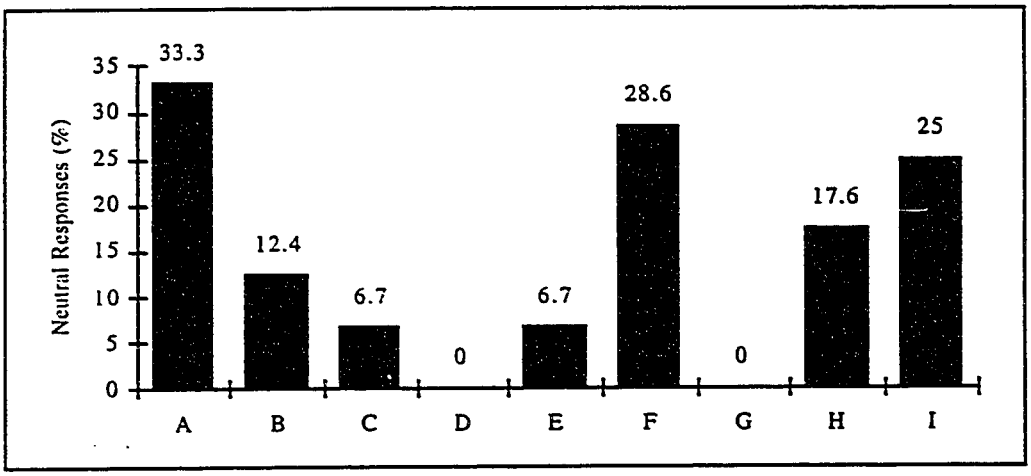


Figure 4.25. Neutral attitude towards the characteristics of estimating systems used for design estimates.

Where,

A: Reliable

B: Easy to use

C: Easy to update

D: Easy to understand the output

E: Compatible with management information system in your firm

F: Provide accurate results

G: Compatible with the technical capabilities that your firm have

H: Easy to adjust to meet changes in parameters

I: Comprehensive to all different types of construction projects

Table 4.69. Comparison between different types of cost estimates regarding the level of satisfaction with cost estimating systems.

Type of estimates	Average mean responses	Average positive responses (%)	Average negative response (%)	Average neutral response (%)
Feasibility cost estimate	2.56	41.98	10.36	47.66
Budget cost estimate	2.48	57.68	2.8	39.52
Design cost estimate	1.89	81.29	4.23	14.48

4.5.2.3.8 Reliability of Design Cost Estimating System

The participating (A/E) firms provided design the cost estimates of projects that were designed and supervised during the last five years. In addition, the participants provided the corresponding bid prices for these projects. The purpose behind exhibiting these estimates and bid prices is to determine the variances between values of different cost estimates and bid prices which, in turn, will provide good and measurable scale of how good are these cost estimates compared with the bid prices, the true costs. Some of the participants, however, declined to provide such information claiming that it is restricted and clients do not allow the disclosure of such information. As a solution, it was recommended to respondents to provide an average variance between the cost estimate values and the bid prices for previous projects. After further reluctance, the participants provided these variances. It is needless to say that the responses are considered the most

vital since it provides true and precise method of evaluating the quality of developed design cost estimates. There were cases where participating (A/E) firms provided bid prices of performed projects prior to the evaluation and determination of the contract values. In these cases, it was assumed that the bid price is the lowest of these bidding values.

Technically, it has been determined that design cost estimates ±10% of the bid prices (Adrian, 1982).

Table 4.70. The overall average of the average variances between design cost estimate and bid prices.

Respondents	Average variance between design estimates and bid prices (±%)
1	0
2	5
3	0
4	9.98
5	8.7
6	1%
7	9.8
8	17
9	10
13	10
14	14
15	10
16	10
17	19
18	10
	average 8.36%

Table 4.70 shows the overall average of the average variances between design cost estimates and bid prices to be ±8.36% compared with ±10%. This result is very encouraging.

4.6 OTHER TYPES OF COST ESTIMATES

Some of the participating (A/E) firms stated that they develop other types of cost estimates. The responses are different in terms of what types of estimates are provided. Therefore, the presentation of results and analysis is going to be by participants and not by types of activities as conducted in earlier sections.

Respondent—1

The name of one cost estimate provided is called "differential cost estimate" and it is developed for the purpose of selecting between different alternatives. The method of developing this cost estimate is as follows:

1. List out the alternatives.
2. List out the elements that affect the alternatives
3. Collect the cost details.
4. Find the incremental cost for each alternative.
5. Find the differential cost among the alternatives.
6. Select the least cost alternative.

This method seems to be similar or one vergin of value engineering analysis. The respondent indicated that they have no variation of applying this method. The participant considered the types of information listed in question 6 to be of extreme importance except the construction method which was determined to be of major importance. The participant

provided "report on the existing facilities" as an additional type of information of extreme importance. It was indicated that this cost estimate requires all cost information used earlier in order to be prepared. The respondent provided "own risk cost" as an additional cost information needed for the development of this cost estimate. It was stated that historical records, standard manuals, and quotes from vendors are the usual sources of cost information. The participants stated that when contingency, cost trending, and construction prorates are used to develop this cost estimate, not adjustment is required on these items. The development of this cost estimate is not carried out using computers. The respondent provided the following characteristics of this cost estimate:

Strengths

1. Reliable.
2. Accurate.

Weaknesses

1. Time consuming.
2. Suitable only for particular applications.
3. When the alternatives change, the methods of developing of the cost estimate changes.

The respondents indicated his extreme satisfaction with the reliability of the cost estimate, providing accurate results, and the compatibility of this cost estimate with the technical capability that his firm has. In addition, the participants indicated that the cost estimate is easy to use, easy to

understand, and compatibility with its management information system provide extreme satisfaction. Finally, the respondent indicated its fair satisfaction with cost estimate ease of updating and fitting of different types of construction projects. In order to improve the procedure of this cost estimating the participants suggested the following:

1. Develop the estimate procedure in computerized program in order to make development of this cost estimate test.

2. The cost details for developing this cost estimate is stored in a data base for easy retrieval.

Respondent—2

Respondent 2 indicated that the name of this cost estimate is called "change order estimate" and the purpose of it is to negotiate change orders in on-going contracts.

1. Identify the scope of change compared with the requirements dictated by the contract.

2. Provide breakdown of the scope in terms of labor and material cost.

3. Include other costs such as equipments transportation, handling, and overhead costs.

4. Determine the total cost by adding all costs.

The participant indicated that the outlined method is followed always and no variations are used.

The participant stated that all types of information listed in question 6 are of extreme importance except the functional program of the facility, the architectural program of the facility, zoning, and economic conditions where the respondent indicated that they are of extreme unimportance. In addition, the participant stated that cost information required for this type of estimate are labor cost, material cost, machine cost, and management cost. Historical records, standard manuals, and current contracts are sources of cost information in order to develop change order estimates. The participant indicated that contingency, cost trending, and construction prorates are not used when developing change order estimates. Also, the participants stated that computers are not used during the development of this cost estimate. The participant provided some characteristics of change order estimate. They are as follows:

Strength

1. Satisfies our clients.
2. Provide effective tool to enable negotiating and settlement of change orders.

Weaknesses

1. None

The participant indicated that he is extremely satisfied with all characteristics of cost estimating systems and provided no recommendations in order to improve the procedures of change order cost estimates.

Respondent—6

The participant called the cost estimate "Technical Report of as Built Projects". The purpose of this estimate is to evaluate remaining construction work. The approach followed in order to develop this cost estimate is as follows:

1. Evaluate the contract, the drawing and the specifications of the project.
2. Conduct site visit to evaluate the finished work and its quality.
3. Make notes of existing changes.
4. Obtain original prices from records
5. Determine the percentage of finished work and its quality.
6. Try to determine the penalty of delay if any, and by whom.
7. Evaluate the cost of finished work and compare it with the contract value and the payments paid.

All the types of input information used earlier were determined to be of importance or higher except for regulation requirements and zoning which

were determined to be of major unimportance. The participants stated that information such as penalty of delay, change orders, payments, material delivered to site are of major importance. All the cost information used earlier were determined to be needed for preparation of this cost estimate. In addition, the participant suggested that "work and contractor category" is also needed for preparing this cost estimate. The respondent indicated that he uses his own historical records and market price as sources of cost information. In addition, the participant indicated that cost trending is the only information in question 9 that require adjustment when developing this cost estimate. The frequency of updating of cost trending were not specified. Computers, on the other hand, are not used when preparing this type of cost estimate.

The characteristics of this cost estimate were provided. They are as follow:

Strength

1. The pricing follow the original pricing when the contract was signed by both parties.

Weaknesses

1. The estimate is not expected to exceed the original price given by the contract despite the escalation of cost between the signing of the contract and the time the estimate is done.

The participant stated that the characteristics of cost estimating systems provide at least fair satisfaction to him. In addition, he provided an additional characteristic which is easy to compare with other methods of pricing which provide major satisfaction to him.

Finally, the participant provided some recommendations in order to improve the procedures of this cost estimate. They are as follows:

1. Use computer program that have all cost information built in it.
2. Improve the development of contracts, drawings, and specifications.
3. Provide breakdown of cost items categorized by labor, material, civil, mechanical, electrical, etc. This approach makes the determination of cost of remaining work easier.

Respondent—14

The participant indicated that the other type of cost estimate developed for owners is called "project cost analysis". The purpose of this estimate is to monitor project expenditure.

The approach of carrying out this type of estimate was not provided by the participant. The participant considered list of input information used earlier of at least major importance and stated that all cost information listed in question 7 are required for the preparation of this cost estimate except "unit cost per area of construction".

The participant indicated that the sources of cost information are historical records and standard manuals. He stated, also, that contingency, cost trending, and construction prorates are adjusted when developing this cost estimate. The frequencies of adjustments are yearly. The participant stated that "Sun Account" Computer program is used during the preparation of this cost estimate. It was indicated that this cost estimate has no strengths or weaknesses.

The participant indicated that he is extremely satisfied with the characteristics of estimating systems. He provided no recommendations of ways to improve the procedure of this cost estimate.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

This chapter presents a summary of the study and a summary of the results.

5.1 SUMMARY OF THE STUDY

Project cost estimation is vital tool for the success of the development of construction projects that have to be developed by owners,(A/E) firms, and construction contractors. This study was conducted to investigate the development of cost estimation by (A/E) firms in the Eastern Province, Saudi Arabia.

This study concentrates on Project Cost Estimation conducted by (A/E) firms on designed and supervised building projects during the last five years. Preliminary questionnaires were mailed to all 153 (A/E) firms operating in the Eastern Province, Saudi Arabia to determine their conformance to the study criteria and solicit their interest in participating in this study. Seventy eight (A/E) firms responded but only Thirty-nine (A/E) firms demonstrated their conformance to the study criteria and, therefore, main questionnaires were mailed to all of them. However, only eighteen responded and participated in the study.

5.2 SUMMARY OF THE RESULTS

This section summarizes the results obtained by this study from performing a research on cost estimation practices in (A/E) firms operating in the Eastern Province of Saudi Arabia. The major summaries are listed below:

5.2.1 Cost Estimating Department and Employees

1. All participating (A/E) firms have estimating groups. The majority of (A/E) firms (72.2%) indicated that they have dedicated cost estimating departments.

2. The estimating groups of the majority of(A/E) firms (88.9%) report to engineering managers. The remaining estimating groups (11.1%) work in the support groups which report directly to executive management.

3. Some of the participating (A/E) firms (59.7%) stated that their estimators have BS in engineering while (28.1%) stated that their estimators have BS in engineering plus special training.

5.2.2 Function of Cost Estimating Department

1. The participating A/E firms prepare cost estimates mostly for new projects and little for renovation projects and for change orders.

2. Most of the participating (A/E) firms prepare all types of cost estimates including budget estimates (27.5%), bid evaluation

estimates (26.9%), progress estimates (11.9%), feasibility estimates (10%), conceptual estimates (10%), control estimates (8.6%), value engineering analysis estimates (2.8%), life cycle costing analysis estimates (1.7%), and project cost analysis estimates (0.05%).

5.2.3 Feasibility, Budget, and Design Estimating Procedures

1. Budget cost estimates are developed by (93.8%) of the participating (A/E) firms while design cost estimates are developed by (87.5%). Feasibility cost estimates and other types of cost estimates are developed by (50%) and (25%) of the (A/E) firms, respectively.

2. The procedures for developing feasibility and budget cost estimates are done by determining the cost per area of building construction plus listing and determining the cost of special requirements. In addition, the cost of major equipment is determined through quotations from vendors. Finally, additional costs for contingency and overhead is determined. Feasibility and budget cost estimates are similar in process except that budget estimates are more detailed. On the other hand, design cost estimates is, also, developed in similar fashion to feasibility and budget cost estimates except that it does not contain the cost per unit of construction factor. Instead, labor and material cost are broken into bill of quantities format and added to it other cost such as contingency, overhead etc.

3. The strengths of these procedures according to most participants include fairly accurate, satisfies clients, factual, project specific, customized to standard projects, follow market trends, and consistent. On the other hand, the weaknesses include time consuming, not automated, labor intensive, costly, and difficult to check and update.

4. Cost information such as Architectural program of the facility, the location of the project, the owner's requirements, the regulation requirements, and site conditions are of major importance to the preparation of cost estimates especially to feasibility and budget cost estimates. The level of importance of these information decreases for design cost estimates than those for budget than those for feasibility cost estimates.

5. Eighty percent of the participating (A/E) firms which prepares design estimates uses computers in developing feasibility cost estimates. On the other hand, 75% of (A/E) firms which prepares budget estimates and 50% of (A/E) firms which prepares feasibility estimates use computers to develop budget and feasibility cost estimates, respectively. The most common computer system used is spread sheet.

6. The respondents are generally satisfied with the characteristics of cost estimating systems and considered them, reliable, easy to use, easy to update, easy to understand the output, compatible with

Management Information Systems, and provide accurate results. The level of satisfaction increases for design cost estimates than that of budget cost estimates than that for feasibility cost estimates.

7. The average variation between feasibility cost estimates and bid prices was determined to be 16.8.%, while it was determined to be 13.6% for budget cost estimates, and 8.36% for design cost estimates.

5.2.4 Other Types of Estimating Procedures

1. The procedure, in general, include the defining of the scope of work by listing all the required steps of actions, providing details of required and deleted materials, determination of labor hours and rate, and applying contingency and overhead and profits. Prior to the determination of the cost estimate, the two parties normally agree on the quantity take off of labor and material involved.

2. The strength of those types of estimates include consistent, factual, project (scope) specific, accurate, and easy to check. Weaknesses include: labor intensive, not automated, and difficulty to agree on material and labor rates.

3. The participants, in general, considered most of the types of cost information of major importance. The level of importance varied from one procedure to another and from one type of information to another for the same procedure.

4. Most of the participants stated that they use computers for developing these types of cost estimates. Spreadsheet was the most common computer system used.

5. The participants, in general, are satisfied with most of the characteristics of these types of cost estimates.

5.3 CONCLUSION

This section summarizes the conclusions reached by conducting cost estimation study on (A/E) firms in the Eastern Province of Saudi Arabia. The major conclusions are outlined below:

5.3.1 Cost Estimating Department and Employees

1. The positioning of estimating groups under the engineering managers is solely done to provide operation convenience only.

2. The participating (A/E) firms are supported with estimators of good engineering background. However, their reliance on estimators with special training is limited.

5.3.2 Function of Cost Estimating Department

1. The majority of the participating (A/E) firms considered cost estimation as a service that can only be provided as part of engineering services.

2. Budget cost estimates and Bid evaluation (design) cost estimates are considered the most common types of estimates practiced by the participating (A/E) firms.

5.3.3 Feasibility, Budget, and Design Cost Estimating Procedures

1. The procedures for developing all types of cost estimates follow lengthy manual procedures.

2. The strengths of all types of cost estimates outweigh the weaknesses. The majority of the weaknesses can be eliminated by the development of automated procedures.

3. The cost information required for all types of cost estimates are dominated with ones that are mostly required at the early stages of project development and, therefore, their level of importance is higher for feasibility then that for budget then that for design cost estimates.

4. The level of satisfaction with the characteristics of cost estimating systems increased as the level of details and, hence, the level of accuracy of these estimating systems increases. Therefore, the level of satisfaction with the characteristics of design cost estimates is higher than that for budget cost estimates than that for feasibility cost estimates.

5. The average variations between feasibility, budget, and design cost estimates and between bid prices were determined to be

exceptionally good compared to technical values. These results could be attributed to long experience of cost estimators, sufficient scope details, and minimum scope changes along the different phases of the project.

5.4 RECOMMENDATIONS

1. It is recommended that estimating departments be part of the project control groups and report directly to executive management of the (A/E) firms.

2. The estimating departments should have estimators with special training in addition to have BS in engineering degrees.

3. It is recommended that (A/E) firms develop other types of cost estimates such as value engineering cost analysis and life cycle costing analysis as they have proven their importance for recent and future project development.

4. In order to improve the procedures of all types of cost estimates, the variance between these estimates and bid values should be performed for all line items instead of the total cost. This, in turn, will identify the parts of the procedures providing the highest variance and, hence, the areas for improvement.

5.5 RECOMMENDATIONS FOR FUTURE STUDIES

1. In order to form an understanding of the extent of cost estimation practice in the Kingdom, cost estimation by other parties which are likely to develop cost estimates such as construction contractors and government agencies should be studied in similar fashion.

2. It is recommended that the subjects covered by this study be thoroughly investigated in order to form better understanding of the characteristics of different areas of cost estimation in (A/E) firms.

3. It is recommended that automated procedures be developed and tested for all types of cost estimates for Saudi Arabia in line with international systems such as means.

VITA

Mr. SALEH ABDULRAHMAN MOHAMMED AL-THUNAIAN was born in Riyadh Al-Khabra, Al-Qassim Region in 1956. He attended Elementary, Intermediate, and High school in Riyadh Al-Khabra. He was sponsored by Saudi Aramco to attend university of Alabama at Birmingham in 1982 and graduated with a B.Sc. degree in Mechanical Engineering in 1987. He re-enrolled at King Fahd University of Petroleum and Minerals (KFUPM) in Construction Engineering and Management program in 1991 as a part time student.

Mr. S.A. Al-Thunaian joined Saudi Aramco as an assistant engineer from 1980-1982. Upon graduating from college in 1987 until now, he has been working as a project engineer in Saudi Aramco Project Management. As part of development assignments in the early stage of his professional career, he worked in various Saudi Aramco organizations such as consulting services, pipelines, inspection, and utilities. He attended several management and technical courses and obtained affiliation to some technical societies.

APPENDIX — I

A/E FIRMS PRESENTLY OPERATING IN THE EASTERN PROVINCE, SAUDI ARABIA

TABLE I.1: VARIOUS TYPES OF INFORMATION REGARDING THE PARTICIPANTS' ORGANIZATION STRUCTURES

TABLE I.2: VARIOUS TYPES OF INFORMATION REGARDING THE ESTIMATING DEPARTMENT

INVITATION LETTERS AND REMINDER

APPENDIX- I

A/E FIRMS PRESENTLY OPERATING

IN THE EASTERN PROVINCE. SAUDI ARABIA

A. Consulting Offices

1. Abdul Rahman Al-Nuaim Consulting Engineers, Al-Ahsa.
2. Al-Shaeb Office for Engineering Consultants and Planners, Al-Ahsa.
3. Nasir Al-Mulhim Office for Engineering Consultations, Al-Ahsa.
4. Al-Tawfiq Office for Engineering Consultations, Al-Ahsa.
5. Al-Bugshi Office for Engineering, Al-Ahsa.
6. Muhammed Al-Ahmadi for Engineering Consultations, Jubail.
7. Al-Jubail Consulting Office, Jubail.
8. Design and Engineering Consulting, Al-Khobar.
9. Ahmed Al-Awaid for Engineering Consultations, Al-Khobar.
10. Al-Hamdan Consulting Office, Al-Khobar.
11. Technical Studies Office, Al-Khobar.
12. Al-Qahtani Office - Consulting Engineers, Al-Khobar.

13. Engineering & Consulting Office, Al-Khobar.

14. Engineering Consultations for Basic Supplies, Al-Khobar.

15. Saudi Consulting and Design Office, Al-Khobar.

16. Othman Al-Othman Consulting Office, Al-Khobar.

17. Consulting Design Engineering, Al-Khobar.

18. Arabian Coordination Office - Consulting Engineers, Al-Khobar.

19. Gulf Consultant, Al-Khobar.

20. Al-Nimran Consulting Office, Al-Khobar.

21. Fawaz Omar Radhi Office, Al-Khobar.

22. Zamil & Turbag Engineering, Al-Khobar.

23. Al-Dammam Center for Engineering, Dammam.

24. Al-Eid Office for Engineering Consulting, Dammam.

25. Khalid Al-Mojil Office, Dammam.

26. Saud Kano Office, Dammam.

27. Said Al-Hisan Office for Engineering Consulting, Dammam.

28. Sulaiman Al-Hamad Office for Engineering Consulting, Dammam.

29. Saudi Coy Consult Co., Dammam.

30. Abdulrahman Al-Shuhail Office, Dammam.

31. Al-Haddad Office for Engineering Consulting, Dammam.

32. Al-Suhaimi Office for Design, Dammam.

33. Saudi Group for Engineering, Dammam.

34. Abdul Mohsin Al-Bilali Office - Consulting Engineers, Dammam.

35. Al-Marhoon Office for Engineering Consulting, Dammam.

36. Engineering & Technical Service, Dammam.

37. Ali Al-Mulla Consulting, Dammam.

38. Saudi Designers, Dammam.

39. Al-Obaidly Office for Engineering Consulting, Dammam.

40. Saudi Consulting Office, Dhahran.

41. Al-Awami Consulting Office, Qatif

42. Waleed Al-Qatari for Engineering, Qatif

43. Saleh Al-Barrak Office for Engineering Consulting, Mubarraz.

44. Al-Ghazal Ofbce for Engineering Consulting, Hofuf

45. Al-Khalifa Office for Engineering Consulting, Hofuf

46. Al-Wadani Office for Engineering, Hofuf

B. Engineering Offices

1. Saad Al-Mansoor Office, Al-Ahsa.
2. Al-Mulhim Office for Engineering Services, Al-Ahsa.
3. Omar Al-Mubarak Office, Al-Ahsa.
4. Nabil M. Al-Kadi Engineering Office, Al-Ahsa.
5. Jamal Simbawa Office, Jubail.
6. Hassan A. Al-Abuainain Engineering Office, Jubail.
7. Riyadh Al-Saad Engineering Office, Jubail.
8. Abdulrahman Bin Zara Engineering Office, Jubail.
9. Mohammad Al-Buainain Engineering Office, Jubail.
10. Ibrahim Al-Ribdi, Al-Khobar.
11. Ihsan Al-Abad Engineering Office, Al-Khobar.
12. Radicon Office, Al-Khobar.
13. Iyad Al-Fadhli Engineering Office, Al-Khobar.
14. Basil Al-Qadib Engineering, Al-Khobar.
15. Baker Al-Hain for Architectural Engineering, Al-Khobar.
16. Haider Al-Haj Engineering Office, Al-Khobar.

17. Khalid S. Al-Saleh Engineering Office, Al-Khobar.

18. Khalid A. Al-Fozan Engineering Office, Al-Khobar.

19. Sami Al-Sanad Office, Al-Khobar.

20. Saleh Al-Mubaiedh Office for Civil Engineering, Al-Khobar.

21. Salah Al-Afaliq Engineering Office, Al-Khobar.

22. Salah Sulaiman Office for Engineering, Al-Khobar.

23. Tariq Al-Wakeel Office, Al-Khobar.

24. Al-Osaimi Office for Engineering, Al-Khobar.

25. Abdul-Aziz M. Ababtain Engineering Office, Al-Khobar.

26. Abdullah Baltyour Engineering Office, Al-Khobar.

27. Abdullah Al-Zamil Engineering Office, Al-Khobar.

28. Adnan Al-Bassam Engineering Office, Al-Khobar.

29. Fareed Al-Maymani Engineering Office, Al-Khobar.

30. Fahad Al-Sharbi Engineering Office, Al-Khobar.

31. Al-Raed Office for Civil Engineering, Al-Khobar.

32. Deewan Office for Design and Architecture, Al-Khobar.

33. Engineering Studies Office, Al-Khobar.

34. Mazin M. Abdu Engineering Office, Al-Khobar.

35. Muhammad Al-Rashid Engineering Office, Al-Khobar.

36. Muhammad Al-Amoudi Engineering Office, Al-Khobar.

37. Muhammad Al-Nafa Engineering Office, Al-Khobar.

38. Nasir Al-Hajri Engineering Office, Al-Khobar.

39. Al-Wabran Office for Civil Engineering, Al-Khobar.

40. Technical & Engineering Office, Dammam.

41. Ihsan F. Abdul Jawad Engineering Office, Dammam.

42. Ahmad Al-Mousa Engineering Office, Dammam.

43. Jamal Al-Binali for Civil Engineering, Dammam.

44. Al-Tamimi Engineering Office, Dammam.

45. Al-Amer Office for Engineering Studies, Dammam.

46. National Office for Engineering Services, Dammam.

47. Sabir Office for Design and Architectural Studies, Dammam.

48. Rashid Al-Oraifi Engineering Office, Dammam.

49. Riyadh Al-Hamood Engineering Office, Dammam.

50. Saad Al-Hiwar Engineering Office, Dammam.

51. Al-Yousef Office for Civil Engineering, Dammam.

52. Salman Al-Amir Engineering Office, Dammam.

53. Samir A. Al-Mahaish Engineering Office, Dammam.

54. Suhil Y. Al-Ali Engineering Office, Dammam.

55. Ojairi Center Design Office, Dammam.

56. Salah A. Al-Thib Engineering Office, Dammam.

57. Arif Bukanan Engineering Office, Dammam.

58. Abdulhakim M. Al-Hamood Engineering Office, Dammam.

59. Abdul Hamid Al-Bigachi Engineering Office, Dammam.

60. Al-Abdul Qadir Engineering Office, Dammam.

61. Al-Abdullatif Office for Engineering Designs, Dammam.

62. Al-Hamid Office for Engineering Designs, Dammam.

63. Abdullah Abuzaid Office for Civil Engineering, Dammam.

64. Abdullah A. Al-Juaib Engineering Office, Dammam.

65. Al-Zawad Office for Civil Engineering, Dammam.

66. Al-Ibrahim Office for Engineering, Dammam.

67. Ali Al-Ghamdi for Electric and Communications, Dammam.

68. Ghassan A. Bahlargah Engineering Office, Dammam.

69. Fadhil Bakhamsin Office for Civil Engineering, Dammam.

70. Eastern Engineering Office, Dammam.

71. Mohammad Al-Harbi Engineering Office, Dammam.

72. Mohammad Y. Al-Safi Engineering Office, Dammam.

73. Naji A. Al-Yahyai Engineering Office, Dammam.

74. Technical Office for Architect and Engineering Sources, Dammam.

75. Jasim Al-Quahmad Engineering Office, Qatif.

76. Riyadh Al-Mustafa Engineering Office, Qatif

77. Riyadh Al-Ibrahim Engineering Office, Qatif.

78. Zaki Al-Buraiki Engineering Office, Qatif

79. Zuhair Al-Madan Engineering Office, Qatif

80. Al-Hijlis Engineering Office, Qatif.

81. Wadea Al-Mustafa Engineering Office, Qatif

82. Abdulaziz A. Al-Sultan Engineering Office, Mubaraz.

83. Abdul Mohsin Al-Mulhim Engineering Office, Mubaraz.

84. Ahmed N. Al-Ajaji Engineering Office, Hofuf

85. Said Al-Marzouq Engineering Office, Hofuf

86. Abdul Rahman Al-Mulhim Engineering Office, Hofuf

87. Hassan Al-Sultan Engineering Office, Hofuf

88. Salim Al-Harbi Engineering Office, Hafr Al-Batin.

89. Muhammad Al-Mutairi Engineering Office, Hafr Al-Batin.

90. Hassan M. Al-Mazel Engineering Office, Saihat.

91. Al-Muraisen Office for Engineering, Sai~wa.

92. Dar Al-Manar Office for Engineering, Dhahran Airport.

93. Tarik K. Al-Haj Engineering Office, Dhahran Airport.

94. Abdullah Al-Muaibed Engineering Office, Dhahran Airport.

95. Fahad A. Bunaharah Engineering Office, Dhahran Airport.

96. Fahad M. Al-Tamimi Engineering Office, Dhahran Airport.

97. Contel Federal System Co., Al-Khobar.

98. Saudi Condvico Ltd. Co., Al-Khobar.

99. Saudi Waberscafedis Overseas Co., Al-Khobar.

100. Harlco Arabia Ltd. Co., Al-Khobar.

101. Abdullah Abal Khail Design Office, Dammam.

102. Dar Al-Riyadh For Engineering Consulting, Dhahran.

103. Saudi Consulting Services, Al-Khobar.

104. Saudi Arabian Bechtel Co., Jubail.

C. Engineering Office (Non-Saudi)

1. Construction Engineering Office, Al-Hasa.

2. Kamal S. Al-Saga Engineering Office, Khobar.

3. Omar S. Bishnaq Engineering Office, Dammam.

Table I.1. Various types of information regarding the organization structure.

Respondent	Number of years in business	Number of branch offices	Number of employees	Annual turn over (SR mm)
1	18	2	300	37.5
2	23	3	200	RI
3	14	0	128	RI
4	21	3	615	RI
5	15	2	141	25
6	15	0	9	1
7	15	1	30	3
8	15	3	350	50
9	37	8	700	RI
10	7	1	151	RI
11	16	1	73	RI
12	8	0	30	100
13	30	4	800	80
14	20	0	320	RI
15	14	0	59	RI
16	12	2	157	RI
17	13	2	263	RI
18	12	1	98	RI

RI: Restricted information

Table 1.2: Various Types of Information Regarding The Estimating Department

Respondent	Availability of estimating dept.	Name of estimating department	Number of employees working as estimators	Nationality of estimators	# of years of experience	# of yrs. of experience as estimators
1	No	No department	3	American, Indian, Canadian	12	1
2	Yes	Estimating group	4	American, Filipino (4)	10	2
3	Yes	Materials dept.	3	Filipino, Indian, Pakistani	8	3
4	Yes	Qty. Surveying	5	English, Filipino, Pakistani, Egyptian (2)	12	8
5	Yes	Project Support	3	American, Filipino, Indian	18	6
6	No	No Dept.	1	Egyptian	8	3
7	No	No Dept.	5	Pakistani, Egyptian, Lebanese, Syria, Palestinian	10	10
8	Yes	Project Contrds.	9	Filipino (4), Indian (3), Lebanese (2)	10	5
9	Yes	Materials & Qtys.	12	Indian (7), Lebanese (5)	10	9
10	Yes	Control coord. unit	3	English, Filipino, Indian	23	4

11	Yes	Civil Dept.	2	Filipino, Egyptian	14	8
12	No	N.R	N.R	No response	—	—
13	Yes	Material section	4	Indian (2), Pakistani, Egyptian	12	7
14	Yes	Eng. Dept.	13	American, Filipino (5), Indian (4), Lebanese (2)	8	7
15	No	No Dept.	1	Egyptian	8	4
16	Yes	Project support	3	American, Filipino, Indian	18	6
17	Yes	Qty. surveying	2	Filipino, Pakistani	8	6
18	Yes	Mat. Dept.	3	Filipino, Indian, Egyptian	8	4

N.R. denotes "no response"

1212

1212

Memorandum:

To

From Dr. A.A. Shash
Chairman of Architectural Engineering, KFUPM

S.A. Al-Thunaian
Student, Construction Engineering & Management, KFUPM

Subject Request for Participation of Thesis Questionnaire

Date: May 02 , 1995

Through the questionnaire attached, you are kindly requested to indicate your interest in participating in a study about construction cost estimation in design offices. The study will be made through another questionnaire that will be made available to your shortly after receiving the attached questionnaire.

The study is part of a master thesis activity that "Construction & Engineering & Management" of KFUPM is conducting on design firms to solicit their input regarding, (1) whether or not they are providing construction cost estimation on designed and supervised projects for owners, (2) how good the procedure used. The study will, also, investigate the extent of which cost estimation is practiced by design firms. It will highlight the present cost estimation strengths, weakness and recommendations on ways to follow in order to provide quality construction cost estimates.

The information provided through the questionnaire will be solely utilized for study purposes and will be dealt with absolute confidentiality. Once the thesis is completed, every participant will be provided with a copy of the thesis which will enable you to evaluate your cost estimation system and provide remedies as necessary.

Should further information is required, please contact S.A. Al-thunaian on 876-6983 or fax 876-6845.

FOR

DR. A.A. SHASH, Chairman
Architectural Engineering
King Fahd University of Petroleum & Minerals

Attachment

Memorandum:

To

From Dr. A.A. Shash
Chairman of Architectural Engineering, KFUPM

S.A. Al-Thunaian
Student, Construction Engineering & Management, KFUPM

Subject Request for Participation of Thesis Questionnaire

Date: August 24 , 1995

Referenced to the above mentioned study, we would like to thank you for expressing your interest in participating in our thesis study. Your response is attached for reference.

As mentioned previously, a copy of the thesis questionnaire is attached for you to complete. Since responding to all questions is essential for having quality research and is the only way to make the research analysis and, hence, results more accurate, your are urged to completely address all questions and indicate should a question be inapplicable or not available. You may provide any attachments or exhibits to any of the questions.

The information provided through the questionnaire will be solely utilized for study purposes and will be dealt with absolute confidentiality. Once the thesis is completed, every participant will be provided with a copy of the thesis which will enable you to evaluate your cost estimation system and provide remedies as necessary.

Your timely response, preferably between 10-14 days, will be highly appreciated.

You may call S.A. Al-Thunaian on 876-6983 (Fax No. 876-6845) when ready for pick-up.

Your usual cooperation is highly appreciated.

Best regards,

for

DR. A.A. SHASH, Chairman
Architectural Engineering
King Fahd University of Petroleum & Minerals

Attachment:

APPENDIX — II

PRELIMINARY QUESTIONNAIRE

MAIN QUESTIONNAIRE

PRELIMINARY QUESTIONNAIRE

For Building Projects that you have designed during the last 5 years:

1. Did you provide construction cost estimate?

   ☐ YES ☐ NO

2. Did you provide construction supervision on projects that you have designed?

   ☐ YES ☐ NO

Contact Name : _____

Address : _____

Telephone No. : _____

Fax No. : _____

Please return your response to:

S.A. AL-THUNAIAN
c/o ARAMCO
P.O. Box 5569
Dhahran - 31311

Tel. : 876-6983
Fax : 876-6845

INFORMATION ABOUT QUESTIONNAIRE

RESPONDENT

POSITION: _____

DEPARTMENT: _____

Section A: Organizational Structure

This section contains questions seeking information about your firm.

1. How many years has your firm been in business? _____ years.

2. How many branch offices (not site offices) does your firm have?

   _____ (excluding main office).

3. What is the total number of employees does your firm have?

   _____ employees.

4. Approximately what is the firm's annual turnover?

   _____ (millions of Saudi Riyals)

5. What is the firm's category?

   a. Consultant ☐

   b. Engineering
   - Architectural ☐
   - Civil ☐
   - Mechanical ☐
   - Chemical ☐
   - Electrical ☐
   - Geological ☐
   - Others, please specify _____

6. What type(s) of projects does your firm design?

		Approximate Proportion
a.	Building (educational, commercial)	_____%
b.	Highway	_____%
c.	Industrial (power plants, refineries)	_____%
d.	Site development	_____%
e.	Others, specify _____	_____%

7. Who are your clients?

		Approximate Proportion
a.	Public (Government)	_____%
b.	Semi-public:	
	1. Saudi Aramco	_____%
	2. SABIC	_____%
	3. Royal Commission	_____%
	4. Others, specify_____	_____%
c.	Private:	
	1. Business	_____%
	2. Residential	_____%
d.	Self (own speculative development, etc.)	_____%

8. What is the average size of projects designed?

		Approximate Proportion
a.	Less than SR 5 million	_____%
b.	SR 5 million to less than SR 25 million	_____%
c.	SR 25 million to less than SR 50 million	_____%
d.	SR 50 million to less than SR 75 million	_____%
e.	SR 75 million to less than SR 100 million	_____%
f.	Over SR 100 million	_____%

9. What are the regions of operation? (Check all that apply)

a.	Eastern Province	☐
b.	Western Province	☐
c.	Central Province	☐
d.	Southern Province	☐
e.	International	☐
f.	Others, please specify _____	☐

10. What type of entity is your firm?

a. Family owned ☐

b. Partnership ☐

c. Joint venture ☐

1. Saudi-Saudi ☐

2. Saudi-Foreign ☐

d. Corporation ☐

e. Others, please specify _____

11. Which of the following project management activities do you perform?

a. Planning and scheduling. ☐

b. Cash budgeting. ☐

c. Cost control. ☐

d. Preparation of accounting reports ☐

e. Quality control (inspection) ☐

f. Others, please specify _____

Section B. Cost Estimating Department

This section contains questions concerning the estimating unit in the firm.

1. Do you provide Cost Estimation services?
   a. No
   b. Yes
      1. Part of the design package _____%
      2. Separate _____%

2. Do you have an estimating department?
   a. No
   b. Yes

3. If yes, what is the name of that department?
   _____.

4. How many employees are working in the estimating department?
   _____ employees.

5. What is the nationality of your estimators?

		Number of employees
a.	American	_____
b.	English	_____
c.	Filipino	_____
d.	Indian	_____
e.	Pakistani	_____
f.	Egyptian	_____
g.	Lebanese	_____
h.	Saudi Arabian	_____
i.	Others, specify	_____

6. What is their average number of years of experience?
   _____ years.

7. On the average, how many years have those estimators been working as estimators for your firm? _____ years.

8. Please indicate the position of the estimating department in the organization structure of your firm.

9. What type of education do your estimators have?

		Approximate Proportion
a.	Mostly Diplomas	_____%
b.	Mostly B.S. in Engineering	_____%
c.	Mostly B.S. in Engineering plus special training	_____%

10. Is cost estimation the primary duty of your employees in the estimating unit?

a. No ☐

b. Yes ☐

Section C: Functions of Cost Estimation Department.

This section contains questions about the purpose and types of cost estimation that are developed by the firm.

1. The estimating group provides: (Please indicate with a tick in the appropriate box. You may select more than one answer.)

			Approximate Proportions
a.	Estimates for new projects	☐	_____%
b.	Estimates for renovation projects	☐	_____%
c.	Estimates for change orders	☐	_____%
d.	Others, specify _____		_____%

2. Which of the following type(s) of estimate(s) do you prepare?

			Approximate Proportions
a.	Feasibility estimates	☐	_____%
b.	Conceptual estimates	☐	_____%
c.	Budget estimates	☐	_____%
d.	Control estimates	☐	_____%
e.	Estimates for owners to use for evaluating contractors' bids	☐	_____%
f.	Progress estimates	☐	_____%
g.	Estimates for Value Engineering analysis	☐	_____%
h.	Estimates for life cycle costing analysis	☐	_____%
i.	Others, please specify _____		_____%

Section D: Feasibility Cost Estimating Procedures

This section contains questions about the procedures followed in preparing feasibility cost estimates for building projects that you designed and supervised during the last 5 years.

1. Do you prepare cost estimates for feasibility studies?

   No ☐ If no, please go to section E, page 38.

   Yes ☐ If yes, please continue.

2. Please describe the approach, i.e. methods, resources, data/records, design documents, etc., your firm utilizes in preparing feasibility cost estimates for construction projects.

3. Does your firm use the above approach for all construction projects?

Yes ☐

No ☐ If no, please describe other variations.

4. Listed below is some possible information for preparing feasibility cost estimates. Besides each, please indicate with a tick (✓) the level of importance of this information.

Type of information	Level of Importance: Extreme Importance	Major Importance	Important	Major un-importance	Extreme Unim-portance
1. Functional program of the facility	☐	☐	☐	☐	☐
2. Architectural program of the facility	☐	☐	☐	☐	☐
3. Location of the project	☐	☐	☐	☐	☐
4. The time of construction start	☐	☐	☐	☐	☐
5. Owner's requirements	☐	☐	☐	☐	☐
6. Regulation requirements	☐	☐	☐	☐	☐
7. Zoning	☐	☐	☐	☐	☐
8. Weather	☐	☐	☐	☐	☐
9. Site conditions	☐	☐	☐	☐	☐
10. Complexity of the project	☐	☐	☐	☐	☐
11. Economic conditions	☐	☐	☐	☐	☐
12. Construction methods	☐	☐	☐	☐	☐
13. Technology requirements	☐	☐	☐		
14. Others, please specify and evaluate,_____	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		

5. Which one(s) of the following cost information do you need for preparing feasibility cost estimates?

a. Labor cost ☐

b. Material cost ☐

c. Machine cost ☐

d. Management cost ☐

e. Escalation cost ☐

f. Interest rate ☐

g. Cost Index ☐

h. Price Index ☐

i. Unit cost per area of construction ☐

j. Others, please specify. _____

_____

_____

6. How does your organization obtain cost information. (Please check all that apply).

a. Own historical records ☐

b. Standard Manuals ☐

c. Other sources, please specify _____.

7. Which of the following items do you adjust feasibility cost estimates for? (You may select more than one answer)

a. Contingency ☐

b. Cost trending ☐

c. Construction prorates ☐

d. Others, please specify _____.

8. Do you update the following items for feasibility cost estimates?

a. Contingency ☐ No ☐ Yes, how often _____.

b. Cost trending ☐ No ☐ Yes, how often _____.

c. Construction Prorates ☐ No ☐ Yes, how often _____.

9. Does your firm use computers for the preparation of feasibility cost estimates?

a. No ☐

b. Yes ☐ , What is the name of the system used? _____ (Optional)

10. Please state the strengths and weaknesses, if any, of the approach your firm utilizes in preparing cost estimates for feasibility studies.

a. Strengths:

b. Weaknesses:

11. Listed below are some possible characteristics of cost estimating system used for feasibility of cost estimates. Besides each, please indicate with a tick (✓) the level of satisfaction of your firm with the current cost estimating system.

	Characteristics	Levels of Satisfaction: Extreme satisfaction	Major satisfaction	Fair satisfaction	Major unsatisfaction	Extreme unsatisfaction
1.	Reliable	☐	☐	☐	☐	☐
2.	Easy to use	☐	☐	☐	☐	☐
3.	Easy to update	☐	☐	☐	☐	☐
4.	Easy to understand the output	☐	☐	☐	☐	☐
5.	Compatible with management information system in your firm.	☐	☐	☐	☐	☐
6.	Provide accurate results	☐	☐	☐	☐	☐
7.	Compatible with the technical capability that your firm has.	☐	☐	☐	☐	☐
8.	Easy to adjust to meet changes in parameters.	☐	☐	☐	☐	☐
9.	Comprehensive to all different types of construction projects.	☐	☐	☐	☐	☐
10.	Others, please specify.	☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		

12. For building projects that you designed and supervised during the last 5 years, please complete the following information:

Project Name / Estimate Amount	Feasibility Estimate (SR. MM)	Bid Price (SR MM)
1.		
2.		
3.		
4.		
5.		
6.		

Section E: Budget Cost Estimating Procedures

This section contains questions about the procedures followed in preparing budget estimates for building projects that you designed and supervised during the last 5 years.

No ☐ If no, please go to section F, page 45.
Yes ☐ If yes, please continue.

2. Please describe the approach, i.e. methods, resources, data/records, design documents, etc., your firm utilizes in preparing budget cost estimates for construction projects.

3. Does your firm use the above approach for all construction projects?

Yes ☐
No ☐ If no, please describe other variations.

4. Listed below is some possible information for preparing budget estimates. Besides each, please indicate with a tick (✓) the level of importance of this information.

Type of information	Level of Importance: Extreme Importance	Major Importance	Important	Major un-importance	Extreme Unim-portance
1. Functional program of the facility	☐	☐	☐	☐	☐
2. Architectural program of the facility	☐	☐	☐	☐	☐
3. Location of the project	☐	☐	☐	☐	☐
4. The time of construction start	☐	☐	☐	☐	☐
5. Owner's requirements	☐	☐	☐	☐	☐
6. Regulation requirements	☐	☐	☐	☐	☐
7. Zoning	☐	☐	☐	☐	☐
8. Weather	☐	☐	☐	☐	☐
9. Site conditions	☐	☐	☐	☐	☐
10. Complexity of the project	☐	☐	☐	☐	☐
11. Economic conditions	☐	☐	☐	☐	☐
12. Construction methods	☐	☐	☐	☐	☐
13. Technology requirements	☐	☐	☐		
14. Others, please specify and evaluate, _____	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		

5. Which one(s) of the following cost information do you need for preparing budget cost estimates?

a. Labor cost ☐
b. Material cost ☐
c. Machine cost ☐
d. Management cost ☐
e. Escalation cost ☐
f. Interest rate ☐
g. Cost Index ☐
h. Price Index ☐
i. Unit cost per area of construction ☐
j. Others, please specify. _____

_____

_____

6. How does your organization obtain cost information. (Please check all that apply).

   a. Own historical records ☐

   b. Standard Manuals ☐

   c. Other sources, please specify _____.

7. Which of the following items do you budget cost estimates for?

   (You may select more than one answer.)

   a. Contingency ☐

   b. Cost trending ☐

   c. Construction prorates ☐

   d. Others, please specify _____.

8. Do you update the following items for budget cost estimates?

   a. Contingency ☐ No ☐ Yes, how often _____.

   b. Cost trending ☐ No ☐ Yes, how often _____.

   c. Construction Prorates ☐ No ☐ Yes, how often _____.

9. Does your firm use computers for the preparation of budget cost estimates?

   a. No ☐

   b. Yes ☐ , What is the name of the system used? _____ (Optional).

10. Please state the strengths and weaknesses, if any, of the approach your firm utilizes in preparing budget cost estimates.

a. Strengths:

b. Weaknesses:

11. Listed below are some possible characteristics of cost estimating system used for budget cost estimates. Besides each, please indicate with a tick (✓) the level of satisfaction of your firm with the current cost estimating system.

	Characteristics	Levels of Satisfaction				
		Extreme satisfaction	Major satisfaction	Fair satisfaction	Major unsatisfaction	Extreme unsatisfaction
1.	Reliable	☐	☐	☐	☐	☐
2.	Easy to use	☐	☐	☐	☐	☐
3.	Easy to update	☐	☐	☐	☐	☐
4.	Easy to understand the output	☐	☐	☐	☐	☐
5.	Compatible with management information system in your firm.	☐	☐	☐	☐	☐
6.	Provide accurate results	☐	☐	☐	☐	☐
7.	Compatible with the technical capability that your firm has.	☐	☐	☐	☐	☐
8.	Easy to adjust to meet changes in parameters.	☐	☐	☐	☐	☐
9.	Comprehensive to all different types of construction projects.	☐	☐	☐	☐	☐
10.	Others, please specify.	☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		

12. For building projects that you designed and supervised during the last 5 years, please complete the following information:

Estimate Amount Project Name	Budget Estimate (SR. MM)	Bid Price (SR MM)
1.		
2.		
3.		
4.		
5.		
6.		

Section F: Design Cost Estimating Procedures

This section contains questions about the procedures followed in preparing design cost estimates for building project that you designed and supervised during the last 5 years.

1. Do you prepare cost estimates for detailed design packages?

   No ☐ If no, please go to section G, page 52.
   Yes ☐ If yes, please continue.

2. Please describe the approach, i.e. methods, resources, data/records, design documents, etc., your firm utilizes in preparing design cost estimates for construction projects.

3. Does your firm use the above approach for all construction projects?

   Yes ☐
   No ☐ If no, please describe other variations.

4. Listed below is some possible information for preparing design estimates. Besides each, please indicate with a tick (✓) the level of importance of this information.

Type of information	Level of Importance: Extreme Importance	Major Importance	Important	Major un-importance	Extreme Unim-portance
1. Functional program of the facility	☐	☐	☐	☐	☐
2. Architectural program of the facility	☐	☐	☐	☐	☐
3. Location of the project	☐	☐	☐	☐	☐
4. The time of construction start	☐	☐	☐	☐	☐
5. Owner's requirements	☐	☐	☐	☐	☐
6. Regulation requirements	☐	☐	☐	☐	☐
7. Zoning	☐	☐	☐	☐	☐
8. Weather	☐	☐	☐	☐	☐
9. Site conditions	☐	☐	☐	☐	☐
10. Complexity of the project	☐	☐	☐	☐	☐
11. Economic conditions	☐	☐	☐	☐	☐
12. Construction methods	☐	☐	☐	☐	☐
13. Technology requirements	☐	☐	☐		
14. Others, please specify and evaluate, _____	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		

5. Which one(s) of the following cost information do you need for preparing design cost estimates?

a. Labor cost ☐
b. Material cost ☐
c. Machine cost ☐
d. Management cost ☐
e. Escalation cost ☐
f. Interest rate ☐
g. Cost Index ☐
h. Price Index ☐
i. Unit cost per area of construction ☐
j. Others, please specify. _____

_____

_____

6. How does your organization obtain cost information. (Please check all that apply).

   a. Own historical records ☐

   b. Standard Manuals ☐

   c. Other sources, please specify _____.

7. Which of the following items do you adjust design cost estimates for? (You may select more than one answer.)

   a. Contingency ☐

   b. Cost trending ☐

   c. Construction prorates ☐

   d. Others, please specify _____.

8. Do you update the following items for design cost estimates?

   a. Contingency ☐ No ☐ Yes, how often _____.

   b. Cost trending ☐ No ☐ Yes, how often _____.

   c. Construction Prorates ☐ No ☐ Yes, how often _____.

9. Does your firm use computers for the preparation of design cost estimates?

   a. No ☐

   b. Yes ☐, What is the name of the system used? _____.

10. Please state the strengths and weaknesses, if any, of the approach your firm utilizes in preparing cost estimates for detailed design package.

a. Strengths:

b. Weaknesses:

11. Listed below are some possible characteristics of cost estimating system used for design cost estimates. Besides each, please indicate with a tick (✓) the level of satisfaction of your firm with the current cost estimating system.

	Characteristics	Levels of Satisfaction: Extreme satisfaction	Major satisfaction	Fair satisfaction	Major unsatisfaction	Extreme unsatisfaction
1.	Reliable	☐	☐	☐	☐	☐
2.	Easy to use	☐	☐	☐	☐	☐
3.	Easy to update	☐	☐	☐	☐	☐
4.	Easy to understand the output	☐	☐	☐	☐	☐
5.	Compatible with management information system in your firm.	☐	☐	☐	☐	☐
6.	Provide accurate results	☐	☐	☐	☐	☐
7.	Compatible with the technical capability that your firm has.	☐	☐	☐	☐	☐
8.	Easy to adjust to meet changes in parameters.	☐	☐	☐	☐	☐
9.	Comprehensive to all different types of construction projects.	☐	☐	☐	☐	☐
10.	Others, please specify.	☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		

12. For building projects that you designed and supervised during the last 5 years, please complete the following information:

Estimate Amount Project Name	Design Estimate (SR. MM)	Bid Price (SR MM)
1.		
2.		
3.		
4.		
5.		
6.		

Section G: Other Cost Estimating Procedures

This section contains questions about other cost estimation procedures that the firm is performing. You are urged to reproduce as many sets as you wish in order to provide information pertaining to the other cost estimation procedures.

1. Does your firm prepare other types of cost estimates?

   No ☐ If no, please stop here.

   Yes ☐ If yes, please continue. (Answer questions 2 through 14 for every cost estimates that you prepare).

2. The cost estimate is called _____.

3. The purpose of this cost estimate is _____.

   Please answer questions 5 through 14 for every cost estimates.

4. Please describe the approach, i.e. methods, resources, data/records, design documents, etc., your firm utilizes in preparing the above mentioned cost estimate for construction projects.

5. Does your firm use the above approach for all construction projects?

Yes ☐

No ☐ If no, please describe other variations.

6. Listed below is some possible information for preparing the above mentioned estimates. Besides each, please indicate with a tick (✓) the level of importance of this information.

Type of information	Level of Importance: Extreme Importance	Major Importance	Important	Major un-importance	Extreme Unim-portance
1. Functional program of the facility	☐	☐	☐	☐	☐
2. Architectural program of the facility	☐	☐	☐	☐	☐
3. Location of the project	☐	☐	☐	☐	☐
4. The time of construction start	☐	☐	☐	☐	☐
5. Owner's requirements	☐	☐	☐	☐	☐
6. Regulation requirements	☐	☐	☐	☐	☐
7. Zoning	☐	☐	☐	☐	☐
8. Weather	☐	☐	☐	☐	☐
9. Site conditions	☐	☐	☐	☐	☐
10. Complexity of the project	☐	☐	☐	☐	☐
11. Economic conditions	☐	☐	☐	☐	☐
12. Construction methods	☐	☐	☐	☐	☐
13. Technology requirements	☐	☐	☐		
14. Others, please specify and evaluate, _____	☐	☐	☐		
	☐	☐	☐		
	☐	☐	☐		

7. Which one(s) of the following cost information do you need for preparing the above mentioned cost estimate?

a. Labor cost ☐
b. Material cost ☐
c. Machine cost ☐
d. Management cost ☐
e. Escalation cost ☐
f. Interest rate ☐
g. Cost Index ☐
h. Price Index ☐
i. Unit cost per area of construction ☐
j. Others, please specify.

_____

_____

8. How does your organization obtain cost information. (Please check all that apply).

   a. Own historical records ☐

   b. Standard Manuals ☐

   c. Other sources, please specify _____.

9. Which of the following items do you adjust the above mentioned cost estimate for? (You may select more than one answer.)

   a. Contingency ☐

   b. Cost trending ☐

   c. Construction prorates ☐

   d. Others, please specify _____.

10. Do you update the following items for the above mentioned cost estimate?

   a. Contingency ☐ No ☐ Yes, how often _____.

   b. Cost trending ☐ No ☐ Yes, how often _____.

   c. Construction Prorates ☐ No ☐ Yes, how often _____.

11. Does your firm use computers for the preparation of the above mentioned cost estimate?

   a. No ☐

   b. Yes ☐, What is the name of the system used?

   _____ (Optional).

12. Please state the strengths and weaknesses, if any, of the approach your firm utilizes in preparing the above mentioned cost estimate?

   a. Strengths:

   b. Weaknesses:

13. Listed below are some possible characteristics of cost estimating system used for the above mentioned cost estimating procedures. Besides each, please indicate with a tick (✓) the level of satisfaction of your firm with the current cost estimating system.

	Characteristics	Levels of Satisfaction: Extreme satisfaction	Major satisfaction	Fair satisfaction	Major unsatisfaction	Extreme unsatisfaction
1.	Reliable	☐	☐	☐	☐	☐
2.	Easy to use	☐	☐	☐	☐	☐
3.	Easy to update	☐	☐	☐	☐	☐
4.	Easy to understand the output	☐	☐	☐	☐	☐
5.	Compatible with management information system in your firm.	☐	☐	☐	☐	☐
6.	Provide accurate results	☐	☐	☐	☐	☐
7.	Compatible with the technical capability that your firm has.	☐	☐	☐	☐	☐
8.	Easy to adjust to meet changes in parameters.	☐	☐	☐	☐	☐
9.	Comprehensive to all different types of construction projects.	☐	☐	☐	☐	☐
10.	Others, please specify.	☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		
		☐	☐	☐		

14. What do you recommend in order to improve this cost estimation procedure?

Recommendation:

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